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ADDRESS BEFORE THE NATIONAL CONSERVATION CONGRESS

By President WILLIAM H. TAFT

CONSERVATION as an economic and political term has come to mean the preservation of our natural resources for economical use, so as to secure the greatest good to the greatest number. In the development of this country, in the hardships of the pioneer, in the energy of the settler, in the anxiety of the investor for quick returns, there was very little time, opportunity, or desire to prevent waste of those resources supplied by nature which could not be quickly transmuted into money; while the investment of capital was so great a desideratum that the people as a community exercised little or no care to prevent the transfer of absolute ownership of many of the valuable natural resources to private individuals, without retaining some kind of control of their use.

The impulse of the whole new community was to encourage the coming of population, the increase of settlement, and the opening up of business; and he who demurred in the slightest degree to any step which promised additional development of the idle resources at hand was regarded as a traitor to his neighbors and an obstructor to public progress. But now that the communities have become old, now that the flush of enthusiastic expansion has died away, now that the would-be pioneers have come to realize that all the richest lands in the country have been taken up, we have perceived the necessity for a change of policy in the disposition of our national resources so as to prevent the continuance of the waste which has characterized our phenomenal growth in the past. To-day we desire to restrict and retain under public control the acquisition and use by the capitalists of our natural resources.

The danger to the state and to the people at large from the waste

and dissipation of our national wealth is not one which quickly impresses itself on the people of the older communities, because its most obvious instances do not occur in their neighborhood, while in the newer part of the country, the sympathy with expansion and development is so strong that the danger is scoffed at or ignored. Among scientific men and thoughtful observers, however, the danger has always been present; but it needed some one to bring home the crying need for a remedy of this evil so as to impress itself on the public mind and lead to the formation of public opinion and action by the representatives of the people. Theodore Roosevelt took up this task in the last two years of his second administration, and well did he perform it.

As president of the United States, I have, as it were, inherited this policy, and I rejoice in my heritage. I prize my high opportunity to do all that an executive can do to help a great people realize a great national ambition. For conservation is national. It affects every man of us, every woman, every child. What I can do in the cause I shall do, not as president of a party, but as president of the whole people.

Conservation is not a question of politics, or of factions, or of persons. It is a question that affects the vital welfare of all of us—of our children and our children's children. I urge that no good can come from meetings of this sort unless we ascribe to those who take part in them, and who are apparently striving worthily in the cause, all proper motives, and unless we judicially consider every measure or method proposed with a view to its effectiveness in achieving our common purpose, and wholly without regard to who proposes it or who will claim the credit for its adoption. The problems are of very great difficulty and call for the calmest consideration and clearest foresight. Many of the questions presented have phases that are new in this country, and it is possible that in their solution we may have to attempt first one way and then another. What I wish to emphasize, however, is that a satisfactory conclusion can only be reached promptly if we avoid acrimony, imputations of bad faith, and political controversy.

The public domain of the government of the United States, including all the cessions from those of the thirteen states that made cessions to the United States and including Alaska, amounted in all to about 1,800,000,000 acres. Of this there is left as purely government property outside of Alaska something like 700,000,000 of acres. Of this the national forest reserves in the United States proper embrace 144,000,000 acres. The rest is largely mountain or arid country, offering some opportunity for agriculture by dry farming and by reclamation, and containing metals as well as coal, phosphates, oils and natural gas. Then the government owns many tracts of land lying along the margins of streams that have water power, the use of which is necessarily in the conversion of the power into electricity and its transmission.

I shall divide my discussion under the heads of (1) agricultural lands; (2) mineral lands—that is, lands containing metalliferous minerals; (3) forest lands; (4) coal lands; (5) oil and gas lands; and (6) phosphate lands.

I feel that it will conduce to a better understanding of the problems presented if I take up each class and describe, even at the risk of tedium, first, what has been done by the last administration and the present one in respect to each kind of land; second, what laws at present govern its disposition; third, what was done by the present congress in this matter; and fourth, the statutory changes proposed in the interest of conservation.

Agricultural Lands

Our land laws for the entry of agricultural lands are now as follows:

The original homestead law, with the requirements of residence and cultivation for five years, much more strictly enforced than ever before.

The enlarged homestead act, applying to non-irrigable lands only, requiring five years' residence and continuous cultivation of one fourth of the area.

The desert-land act, which requires on the part of the purchaser the ownership of a water right and thorough reclamation of the land by irrigation, and the payment of $1.25 per acre.

The donation or Carey act, under which the state selects the land and provides for its reclamation, and the title vests in the settler who resides upon the land and cultivates it and pays the cost of the reclamation.

The national reclamation homestead law, requiring five years' residence and cultivation by the settler on the land irrigated by the government, and payment by him to the government of the cost of reclamation.

There are other acts, but not of sufficient general importance to call for mention unless it is the stone and timber act, under which every individual, once in his lifetime, may acquire 160 acres of land, if it has valuable timber on it or valuable stone, by paying the price of not less than $2.50 per acre fixed after examination of the stone or timber by a government appraiser. In times past a great deal of fraud has been perpetrated in the acquisition of lands under this act; but it is now being much more strictly enforced, and the entries made are so few in number that it seems to serve no useful purpose and ought to be repealed.

The present congress passed a bill of great importance, severing the ownership of coal by the government in the ground from the surface and permitting homestead entries upon the surface of the land which, when perfected, give the settler the right to farm the surface, while the coal beneath the surface is retained in ownership by the government and may be disposed of by it under other laws.

There is no crying need for radical reform in the methods of disposing of what are really agricultural lands. The present laws have worked well. The enlarged homestead law has encouraged the successful farming of lands in the semi-arid regions. Of course, the teachings of the agricultural department as to how these sub-arid lands may be treated and the soil preserved for useful culture are of the very essence of conservation. Then conservation of agricultural lands is shown in the reclamation of arid lands by irrigation, and I should devote a few words to what the government has done and is doing in this regard.

Reclamation

By the reclamation act a fund has been created of the proceeds of the public lands of the United States with which to construct works for storing great bodies of water at proper altitudes, from which, by a suitable system of canals and ditches, the water is to be distributed over the arid and sub-arid lands of the government to be sold to settlers at a price sufficient to pay for the improvements. Primarily, the projects are and must be for the improvement of public lands. Incidentally, where private land is also within the reach of the water supply, the furnishing at cost or profit of this water to private owners by the government is held by the federal court of appeals not to be a usurpation of power. But certainly this ought not to be done except from surplus water, not needed for government land.

About thirty projects have been set on foot distributed through the public land states in accord with the statute, by which the allotments from the reclamation fund are required to be as near as practicable in proportion to the proceeds from the sale of the public lands in the respective states. The total sum already accumulated in the reclamation fund is $60,273,258.22, and of that all but $6,491,955.34 has been expended.

It became very clear to congress at its last session, from the statements made by experts, that these thirty projects could not be promptly completed with the balance remaining on hand or with the funds likely to accrue in the near future. It was found, moreover, that there are many settlers who have been led into taking up lands with the hope and understanding of having water furnished in a short time, who are left in a most distressing situation. I recommended to congress that authority be given to the secretary of the interior to issue bonds in anticipation of the assured earnings by the projects, so that the projects, worthy and feasible, might be promptly completed and the settlers might be relieved from their present inconvenience and hardship. In authorizing the issue of these bonds, congress limited the application of their proceeds to those projects which a board of army engineers, to be appointed by the president, should examine and determine to be

feasible and worthy of completion. The board has been appointed and soon will make its report.

Suggestions have been made that the United States ought to aid in the drainage of swamp lands belonging to the states or private owners, because, if drained, they would be exceedingly valuable for agriculture and contribute to the general welfare by extending the area of cultivation. I deprecate the agitation in favor of such legislation. It is inviting the general government into contribution from its treasury toward enterprises that should be conducted either by private capital or at the instance of the state. In these days there is a disposition to look too much to the federal government for everything. I am liberal in the construction of the constitution with reference to federal power; but I am firmly convinced that the only safe course for us to pursue is to hold fast to the limitations of the constitution and to regard as sacred the powers of the states. We have made wonderful progress and at the same time have preserved with judicial exactness the restrictions of the constitution. There is an easy way in which the constitution can be violated by congress without judicial inhibition, to wit, by appropriations from the national treasury for unconstitutional purposes. It will be a sorry day for this country if the time ever comes when our fundamental compact shall be habitually disregarded in this manner.

Mineral Lands

By mineral lands I mean those lands bearing metals, or what are called metalliferous minerals. The rules of ownership and disposition of these lands were first fixed by custom in the west, and then were embodied in the law, and they have worked, on the whole, so fairly and well that I do not think it is wise now to attempt to change or better them. The apex theory of tracing title to a lode has led to much litigation and dispute and ought not to have become the law, but it is so fixed and understood now that the benefit to be gained by a change is altogether outweighed by the inconvenience that would attend the introduction of a new system. So, too, the proposal for the government to lease such mineral lands and deposits and to impose royalties might have been in the beginning a good thing, but now that most of the mineral land has been otherwise disposed of it would be hardly worth while to assume the embarrassment of a radical change.

Forest Lands

Nothing can be more important in the matter of conservation than the treatment of our forest lands. It was probably the ruthless destruction of forests in the older states that first called attention to a halt in the waste of our resources. This was recognized by congress by an act authorizing the executive to reserve from entry and set aside public

timber lands as national forests. Speaking generally, there has been reserved of the existing forests about 70 per cent. of all the timber lands of the government. Within these forests (including 26,000,000 acres in two forests in Alaska) are 192,000,000 of acres, of which 166,000,000 of acres are in the United States proper, and include within their boundaries something like 22,000,000 of acres that belong to the state or to private individuals. We have, then, excluding Alaska forests, a total of about 144,000,000 acres of forests belonging to the government which is being treated in accord with the principles of scientific forestry.

The law now prohibits the reservation of any more forest lands in Oregon, Washington, Idaho, Montana, Colorado and Wyoming, except by act of congress. I am informed by the department of agriculture that the government owns other tracts of timber land in these states which should be included in the forest reserves. I expect to recommend to congress that the limitation herein imposed shall be repealed.

In the present forest reserves there are lands which are not properly forest land, and which ought to be subject to homestead entry. This has caused some local irritation. We are carefully eliminating such lands from forest reserves, or where their elimination is not practicable, listing them for entry under the forest homestead act. Congress ought to trust the executive to use the power of reservation only with respect to land covered by timber or which will be useful in the plan of reforestation. During the present administration 6,250,000 acres of land, largely non-timbered, have been excluded from forest reserves, and 3,500,000 acres of land principally valuable for forest purposes have been included in forest reserves, making a reduction in forest reserves of non-timbered land amounting to 2,750,000 acres. The Bureau of Forestry since its creation has initiated reforestation on 5,600 acres.

A great deal of the forest land is available for grazing. During the past year the grazing lessees numbered 25,400, and they pastured upon the forest reserves 1,400,000 cattle, 84,540 horses and 7,580,400 sheep, for which the government received $986,715—a decrease from the preceding year of $45,470, due to the fact that no money was collected or received for grazing on the non-timbered lands eliminated from the forest reserve. Another source of profit in the forestry is the receipts for timber sold. This year they amounted to $1,043,000, an increase of $307,000 over the receipts of last year. This increase is due to the improvement in transportation to market and to the greater facility with which the timber can be reached.

The government timber in this country amounts to only one fourth of all the timber, the rest being in private ownership. Only 3 per cent. of that which is in private ownership is looked after properly and treated according to modern rules of forestry. The usual destructive waste and neglect continues in the remainder of the forests owned by

private persons and corporations. It is estimated that fire alone destroys fifty million dollars' worth of timber a year. The management of forests not on public land is beyond the jurisdiction of the federal government.

If anything can be done by law it must be done by the state legislatures. I believe that it is within their constitutional power to require the enforcement of regulations in the general public interest, as to fire and other causes of waste in the management of forests owned by private individuals and corporations. Exactly how far these regulations can go and remain consistent with the rights of private ownership, it is not necessary to discuss; but I call attention to the fact that a very important part of conservation must always fall upon the state legislatures, and that they would better be up and doing if they would save the waste and denudation and destruction through private greed or accidental fires that have made barren many square miles of the older states.

I have shown sufficiently the conditions as to federal forestry to indicate that no further legislation is needed at the moment except an increase in the fire protection to national forests, and an act vesting the executive with full power to make forest reservations in every state where government land is timber-covered, or where the land is needed for forestry purposes.

Other Land Withdrawals

When President Roosevelt became fully advised of the necessity for the change in our disposition of public lands, especially those containing coal, oil, gas, phosphates, or water-power sites, he began the exercise of the power of withdrawal by executive order, of lands subject by law to homestead and the other methods of entering for agricultural lands. The precedent he set in this matter was followed by the present administration. Doubt had been expressed in some quarters as to the power in the executive to make such withdrawals. The confusion and injustice likely to arise if the courts were to deny the power led me to appeal to congress to give the president the express power. Congress has complied. The law as passed does not expressly validate or confirm previous withdrawals, and therefore as soon as the new law was passed, I myself confirmed all the withdrawals which had theretofore been made by both administrations by making them over again. This power of withdrawal is a most useful one, and I do not think it is likely to be abused.

Coal Lands

The next subject, and one most important for our consideration, is the disposition of the coal lands in the United States and in Alaska. First, as to those in the United States. At the beginning of this ad-

ministration there were classified coal lands amounting to 5,476,000 acres, and there were withdrawn from entry for purposes of classification 17,867,000 acres. Since that time there have been withdrawn by my order from entry for classification 77,648,000 acres, making a total withdrawal of 95,515,000 acres. Meantime, of the acres thus withdrawn, 11,371,000 have been classified and found not to contain coal, and have been restored to agricultural entry and 4,356,000 acres have been classified as coal lands; while 79,788,000 acres remain withdrawn from entry and await classification. In addition 336,000 acres have been classified as coal lands without prior withdrawal, thus increasing the classified coal lands to 10,168,000 acres.

Under the laws providing for the disposition of coal lands, the minimum price at which lands are permitted to be sold is $10 an acre; but the secretary of the interior has the power to fix a maximum price and to sell at that price. By the first regulations governing appraisal, approved April 8, 1907, the minimum was $10, as provided by law, and the maximum was $100, and the highest price actually placed upon any land sold was $75. Under the new regulations, adopted April 10, 1909, the maximum price was increased to $300, except in regions where there are large mines, where no maximum limit is fixed, and the price is determined by the estimated tons of coal to the acre. The highest price fixed for any land under this regulation has been $608. The appraised value of the lands classified as coal lands and valued under the new and old regulations is shown to be as follows: 4,303,921 acres, valued under the old regulation at $77,644,329, an average of $18 an acre; and 5,864,702 acres classified and valued under the new regulation at $394,203,242, or a total of 10,168,623 acres, valued at $471,847,571.

For the year ending March 31, 1909, 227 coal entries were made, embracing an area of 35,331 acres, which sold for $663,020.40. For the year ending March 31, 1910, there were 176 entries, embracing an area of 23,413 acres, which sold for $608,813; and down to August, 1910, there were but 17 entries, with an area of 1,720 acres, which sold for $33,910.60, making a disposition of the coal lands in the last two years of about 60,000 acres for $1,305,000.

The present congress, as already said, has separated the surface of coal lands, either classified or withdrawn for classification, from the coal beneath, so as to permit at all times homestead entries upon the surface of lands useful for agriculture and to reserve the ownership in the coal to the government. The question which remains to be considered is whether the existing law for the sale of the coal in the ground should continue in force or be repealed, and a new method of disposition adopted. Under the present law the absolute title in the coal beneath the surface passes to the grantee of the government. The price fixed is upon an estimated amount of the tons of coal per acre beneath the

surface, and the prices are fixed so that the earnings will only be a reasonable profit upon the amount paid and the investment necessary. But, of course, this is more or less guesswork, and the government parts with the ownership of the coal in the ground absolutely.

Authorities of the Geological Survey estimate that in the United States to-day there is a supply of about 3,000 billions of tons of coal, and that of this, 1,000 billions are in the public domain. Of course, the other 2,000 billions are within private ownership, and under no more control as to the use or the prices at which the coal may be sold than any other private property. If the government leases the coal lands and acts as any landlord would, and imposes conditions in its leases like those which are now imposed by the owners in fee of coal mines in the various coal regions of the east, then it would retain over the disposition of the coal deposits a choice as to the assignee of the lease, a power of resuming possession at the end of the term of the lease, or of readjusting terms at fixed periods of the lease, which might easily be framed to enable it to exercise a limited but effective control in the disposition and sale of the coal to the public.

It has been urged that the leasing system has never been adopted in this country, and that its adoption would largely interfere with the investment of capital and the proper development and opening up of the coal resources. I venture to differ entirely from this view. My investigations show that many owners of mining property of this country do not mine it themselves, and do not invest their money in the plants necessary for the mining, but they lease their properties for a term of years varying from twenty to thirty and forty years, under conditions requiring the erection of a proper plant and the investment of a certain amount of money in the development of the mines, and fixing a rental and a royalty, sometimes an absolute figure and sometimes one proportioned to the market value of the coal. Under this latter method the owner of the mine shares in the prosperity of his lessees when coal is high and the profits good, and also shares to some extent in their disappointment when the price of coal falls.

I have looked with some care into a report made at the instance of President Roosevelt upon the disposition of coal lands in Australia, Tasmania and New Zealand. These are peculiarly mining countries, and their experience ought to be most valuable. In all these countries the method for the disposition and opening of coal mines originally owned by the government is by granting leasehold, and not by granting an absolute title. The terms of the leases run all the way from twenty to fifty years, while the amount of land which may be leased to any individual there is from 320 acres to 2,000 acres. It appears that a full examination was made, and the opinions of all the leading experts on the subject were solicited and given, and that with one accord they

approved in all respects the leasing system. Its success is abundantly shown. It is possible that at first considerable latitude will have to be given to the executive in drafting these forms of lease, but as soon as experiment shall show which is the most workable and practicable, its use should be provided for specifically by statute.

The question as to how great an area ought to be included in a lease to one individual or corporation is not free from difficulty; but in view of the fact that the government retains control as owner, I think there might be some liberality in the amount leased, and that 2,500 acres would not be too great a maximum.

By the opportunity to readjust the terms upon which the coal shall be held by the tenant, either at the end of each lease or at periods during the term, the government may secure the benefit of sharing in the increased price of coal and the additional profit made by the tenant. By imposing conditions in respect to the character of the work to be done in the mines, the government may control the character of the development of the mines and the treatment of employees with reference to safety. By denying the right to transfer the lease except by the written permission of the governmental authorities, it may withhold the needed consent when it is proposed to transfer the leasehold to persons interested in establishing a monopoly of coal production in any state or neighborhood. As one third of all the coal supply is held by the government, it seems wise that it should retain such control over the mining and the sale as the relation of lessor to lessee furnishes. The change from the absolute grant to the leasing system will involve a good deal of trouble in the outset, and the training of experts in the matter of making proper leases; but the change will be a good one, and can be made. The change is in the interest of conservation, and I am glad to approve it.

Alaska Coal Lands

The investigations of the geological survey show that the coal properties in Alaska cover about 1,200 square miles, and that there are known to be available about fifteen billion tons. This is, however, an underestimate of the coal in Alaska, because further developments will probably increase this amount many times; but we can say with considerable certainty that there are two fields on the Pacific slope which can be reached by railways at a reasonable cost from deep water—in one case of about fifty miles and in the other case of about 150 miles—which will afford certainly six billion tons of coal, more than half of which is of a very high grade of bituminous and of anthracite. It is estimated to be worth, in the ground, one half a cent a ton, which makes its value per acre from $50 to $500. The coking-coal lands of Pennsylvania are worth from $800 to $2,000 an acre, while other Appalachian fields are worth from $10 to $386 an acre, and the field in the central states from

$10 to $2,000 an acre, and in the Rocky Mountains $10 to $500 an acre. The demand for coal on the Pacific coast is for about 4,500,000 tons a year. It would encounter the competition of cheap fuel oil, of which the equivalent of 12,000,000 tons of coal a year is used there. It is estimated that the coal could be laid down at Seattle or San Francisco, a high-grade bituminous, at $4 a ton, and anthracite at $5 or $6 a ton. The price of coal on the Pacific slope varies greatly from time to time in the year and from year to year—from $4 to $12 a ton.

With a regular coal supply established, the expert of the geological survey, Mr. Brooks, who has made a report on the subject, does not think there would be an excessive profit in the Alaska coal mining because the price at which the coal could be sold would be considerably lowered by competition from these fields and by the presence of crude fuel oil. The history of the laws affecting the disposition of Alaska coal lands shows them to need amendment badly. Speaking of them, Mr. Brooks says:

"The first act, passed June 6, 1900, simply extended to Alaska the provisions of the coal-land laws in the United States. The law was ineffective, for it provided that only subdivided lands could be taken up, and there were then no land surveys in Alaska. The matter was rectified by the act of April 28, 1904, which permitted unsurveyed lands to be entered and the surveys to be made at the expense of the entrymen. Unfortunately, the law provided that only tracts of 160 acres could be taken up, and no recognition was given to the fact that it was impracticable to develop an isolated coal field requiring the expenditure of a large amount of money by such small units. Many claims were staked, however, and surveys were made for patents. It was recognized by everybody familiar with the conditions that after patent was obtained these claims would be combined in tracts large enough to assure successful mining operations. No one experienced in mining would, of course, consider it feasible to open a coal field on the basis of single 160-acre tracts. The claims for the most part were handled in groups, for which one agent represented the several different owners. Unfortunately, a strict interpretation of the statute raised the question whether even a tacit understanding between claim owners to combine after patents had been obtained was not illegal. Remedial legislation was sought and enacted in the statute of May 28, 1908. This law permitted the consolidation of claims staked previous to November 12, 1906, in tracts of 2,560 acres. One clause of this law invalidated the title if any individual or corporation at any time in the future owned any interest whatsoever, directly or indirectly, in more than one tract. The purpose of this clause was to prevent the monopolization of coal fields; its immediate effect was to discourage capital. It was felt by many that this clause might lead to forfeiture of title through the acci-

dents of inheritance, or might even be used by the unscrupulous in blackmailing. It would appear that land taken up under this law might at any time be forfeited to the government through the action of any individual who, innocently or otherwise, obtained interest in more than one coal company. Such a title was felt to be too insecure to warrant the large investments needed for mining developments. The net result of all this is that no titles to coal lands have been passed."

On November 12, 1906, President Roosevelt issued an executive order withdrawing all coal lands from location and entry in Alaska. On May 16, 1907, he modified the order so as to permit valid locations made prior to the withdrawal on November 12, 1906, to proceed to entry and patent. Prior to that date some 900 claims had been filed, most of them said to be illegal because either made fraudulently by dummy entrymen in the interests of one individual or corporation, or because of agreements made prior to location between the applicants to cooperate in developing the lands. There are 33 claims for 160 acres each, known as the "Cunningham claims," which are claimed to be valid on the ground that they were made by an attorney for 33 different and bona-fide claimants who, as alleged, paid their money and took the proper steps to locate their entries and protect them.

The representatives of the government in the hearings before the land office have attacked the validity of these Cunningham claims on the ground that prior to their location there was an understanding between the claimants to pool their claims after they had been perfected and unite them in one company. The trend of decision seems to show that such an agreement would invalidate the claims, although under the subsequent law of May 28, 1908, the consolidation of such claims was permitted, after location and entry, in tracts of 2,560 acres.

It would be, of course, improper for me to intimate what the result of the issue as to the Cunningham and other Alaska claims is likely to be, but it ought to be distinctly understood that no private claims for Alaska coal lands have as yet been allowed or perfected, and also that whatever the result as to pending claims, the existing coal-land laws of Alaska are most unsatisfactory and should be radically amended.

To begin with, the purchase price of the land is a flat rate of $10 per acre, although, as we have seen, the estimate of the agent of the geological survey would carry up the maximum of value to $500 an acre. In my judgment, it is essential in the proper development of Alaska that these coal lands should be opened, and that the Pacific slope should be given the benefit of the comparatively cheap coal of fine quality which can be furnished at a reasonable price from these fields; but the public, through the government, ought certainly to retain a wise control and interest in these coal deposits, and I think it may do so safely if congress will authorize the granting of leases, as already sug-

gested for government coal lands in the United States, with provisions forbidding the transfer of the leases except with the consent of the government, thus preventing their acquisition by a combination or monopoly and upon limitations as to the area to be included in any one lease to one individual, and at a certain moderate rental, with royalties upon the coal mined proportioned to the market value of the coal either at Seattle or at San Francisco. Of course, such leases should contain conditions requiring the erection of proper plants, the proper development by modern mining methods of the properties leased, and the use of every known and practical means and device for saving the lives of the miners.

The government of the United States has much to answer for in not having given proper attention to the government of Alaska and the development of her resources for the benefit of all the people of the country. I would not force development at the expense of a present or future waste of resources; but the problem as to the disposition of the coal lands for present and future use can be wisely and safely settled in one session if congress gives it careful attention.

Oil and Gas Lands

In the last administration there were withdrawn from agricultural entry 2,820,000 acres of supposed oil land in California; about a million and a half acres in Louisiana, of which only 6,500 acres were known to be vacant, unappropriated land; 75,000 acres in Oregon, and 174,000 acres in Wyoming, making a total of nearly four millions of acres. In September, 1909, I directed that all public oil lands, whether then withdrawn or not, should be withheld from disposition pending congressional action, for the reason that the existing placer mining law, although made applicable to deposits of this character, is not suitable to such lands, and for the further reason that it seemed desirable to reserve certain fuel-oil deposits for the use of the American navy. Accordingly the form of all existing withdrawals was changed, and new withdrawals aggregating 2,750,000 acres were made in Arizona, California, Colorado, New Mexico, Utah and Wyoming. Field examinations during the year showed that of the original withdrawals, 2,170,000 acres were not valuable for oil, and they were restored for agricultural entry. Meantime, other withdrawals of public oil lands in these states were made, so that July 1, 1910, the outstanding withdrawals then amounted to 4,550,000 acres.

The needed oil and gas law is essentially a leasing law. In their natural occurrence, oil and gas can not be measured in terms of acres, like coal and it follows that exclusive title to these products can normally be secured only after they reach the surface. Oil should be disposed of as a commodity in terms of barrels of transportable product

rather than in acres of real estate. This is, of course, the reason for the practically universal adoption of the leasing system wherever oil land is in private ownership. The government thus would not be entering on an experiment, but simply putting into effect a plan successfully operated in private contracts. Why should not the government as a land owner deal directly with the oil producer rather than through the intervention of a middleman to whom the government gives title to the land?

The principal underlying feature of such legislation should be the exercise of beneficial control rather than the collection of revenue. As not only the largest owner of oil lands, but as a prospective large consumer of oil by reason of the increasing use of fuel oil by the navy, the federal government is directly concerned both in encouraging rational development and at the same time insuring the longest possible life to the oil supply. The royalty rates fixed by the government should neither exceed nor fall below the current rates. But much more important than revenue is the enforcement of regulations to conserve the public interest so that the convenants of the lessees shall specifically safeguard oil fields against the penalties from careless drillings and of production in excess of transportation facilities or of market requirements.

One of the difficulties presented, especially in the California fields, is that the Southern Pacific Railroad owns every other section of land in the oil fields, and in those fields the oil seems to be in a common reservoir or series of reservoirs, communicating through the oil sands, so that the excessive draining of oil at one well, or on the railroad territory generally, would exhaust the oil in the government land. Hence it is important that if the government is to have its share of the oil it should begin the opening and development of wells on its own property.

In view of the joint ownership which the government and the adjoining land-owners like the Southern Pacific Railroad have in the oil reservoirs below the surface, it is a most interesting and intricate question, difficult of solution, but one which ought to address itself at once to the state lawmakers, how far the state legislature might impose appropriate restrictions to secure an equitable enjoyment of the common reservoir, and to prevent waste and and excessive drainage by the various owners having access to this reservoir.

It has been suggested, and I believe the suggestion to be a sound one, that permits be issued to a prospector for oil giving him the right to prospect for two years over a certain tract of government land for the discovery of oil, the right to be evidenced by a license for which he pays a small sum. When the oil is discovered, then he acquires title to a certain tract, much in the same way as he would acquire title under a mining law. Of course, if the system of leasing is adopted, then he

would be given the benefit of a lease upon terms like that above suggested. What has been said in respect to oil applies also to government gas lands.

Under the proposed oil legislation, especially where the government oil lands embrace an entire oil field, as in many cases, prospectors, operators, consumers and the public can be benefited by the adoption of the leasing system. The prospector can be protected in the very expensive work that necessarily antedates discovery; the operator can be protected against impairment of the productiveness of the wells which he has leased by reason of control of drilling and pumping of other wells too closely adjacent, or by the prevention of improper methods as employed by careless, ignorant or irresponsible operators in the same field which result in the admission of water to the oil sands; while, of course, the consumer will profit by whatever benefits the prospector or operator receives in reducing the first cost of the oil.

Phosphate Lands

Phosphorus is one of the three essentials to plant growth, the other elements being nitrogen and potash. Of these three, phosphorus is by all odds the scarcest element in nature. It is easily extracted in useful form from the phosphate rock, and the United States contains the greatest known deposits of this rock in the world. They are found in Wyoming, Utah and Florida, as well as in South Carolina, Georgia and Tennessee. The government phosphate lands are confined to Wyoming, Utah and Florida. Prior to March 4, 1909, there were 4,000,000 acres withdrawn from agricultural entry on the ground that the land covered phosphate rock. Since that time, 2,322,000 acres of the land thus withdrawn was found not to contain phosphate in profitable quantities, while 1,678,000 acres was classified properly as phosphate lands. During this administration there has been withdrawn and classified 437,000 acres, so that to-day there is classified as phosphate-rock land 2,115,000 acres.

This rock is most important in the composition of fertilizers to improve the soil, and as the future is certain to create an enormous demand throughout this country for fertilization, the value to the public of such deposits as these can hardly be exaggerated. Certainly with respect to these deposits a careful policy of conservation should be followed. Half of the phosphate of the rock that is mined in private fields in the United States is exported. As our farming methods grow better the demand for the phosphate will become greater, and it must be arranged so that the supply shall equal the needs of the country.

It is uncertain whether the placer or lode law applies to the government phosphate rock. There is, therefore, necessity for some definite and well-considered legislation on this subject, and in aid of such legis-

lation all of the government lands known to contain valuable phosphate rock are now withdrawn from entry. A law that would provide a leasing system for the phosphate deposits, together with a provision for the separation of the surface and mineral rights as is already provided for in the case of coal, would seem to meet the need of promoting the development of these deposits and their utilization in the agricultural lands of the west. If it is thought desirable to discourage the exportation of phosphate rock and the saving of it for our own lands, this purpose could be accomplished by conditions in the lease granted by the government to its lessees. Of course, under the constitution the government could not tax and could not prohibit the exportation of phosphate, but as proprietor and owner of the lands in which the phosphate is deposited it could impose conditions upon the kind of sales, whether foreign or domestic, which the lessees might make of the phosphate mined.

The tonnage represented by the phosphate lands in government ownership is very great, but the lesson has been learned in the case of such lands that have passed into private ownership in South Carolina, Florida and Tennessee that the phosphate deposits there are in no sense inexhaustible. Moreover, it is also well understood that in the process of mining phosphate, as it has been pursued, much of the lower grade of phosphate rock, which will eventually all be needed has been wasted beyond recovery. Such wasteful methods can easily be prevented, so far as the government land is concerned, by conditions inserted in the leases.

Water-power Sites

Prior to March 4, 1909, there had been, on the recommendation of the reclamation service, withdrawn from agricultural entry, because they were regarded as useful for power sites which ought not to be disposed of as agricultural lands, tracts amounting to about 4,000,000 acres. The withdrawals were hastily made and included a great deal of land that was not useful for power sites. They were intended to include the power sites on twenty-nine rivers in nine states. Since that time 3,475,442 acres have been restored for settlement of the original 4,000,000, because they do not contain power sites; and meantime there have been newly withdrawn 1,245,892 acres on vacant public land and 211,007 acres on entered public land, or a total of 1,456,899 acres. These withdrawals made from time to time cover all the power sites included in the first withdrawals, and many more, on 135 rivers and in 11 states.

The disposition of these power sites involves one of the most difficult questions presented in carrying out practical conservation. The forest service, under a power found in the statute, has leased a number of these power sites in forest reserves by revocable leases, but no such power exists with respect to power sites that are not located within forest

reserves, and the revocable system of leasing is, of course, not a satisfactory one for the purpose of inviting the capital needed to put in proper plants for the transmutation of power.

The statute of 1891 with its amendments permits the secretary of the interior to grant perpetual easements or rights of way from water sources over public lands for the primary purpose of irrigation and such electrical current as may be incidentally developed, but no grant can be made under this statute to concerns whose primary purpose is generating and handling electricity. The statute of 1901 authorizes the secretary of the interior to issue revocable permits over the public lands to electrical-power companies, but this statute is wofully inadequate because it does not authorize the collection of a charge or fix a term of years. Capital is slow to invest in an enterprise founded on a permit revocable at will.

The subject is one that calls for new legislation. It has been thought that there was danger of combination to obtain possession of all the power sites and to unite them under one control. Whatever the evidence of this, or lack of it, at present we have had enough experience to know that combination would be profitable, and the control of a great number of power sites would enable the holders or owners to raise the price of power at will within certain sections; and the temptation would promptly attract investors, and the danger of monopoly would not be a remote one.

However this may be, it is the plain duty of the government to see to it that in the utilization and development of all this immense amount of water power, conditions shall be imposed that will prevent monopoly, and will prevent extortionate charges, which are the accompaniment of monopoly. The difficulty of adjusting the matter is accentuated by the relation of the power sites to the water, the fall and flow of which create the power. In the states where these sites are the riparian owner does not control or own the power in the water which flows past his land. That power is under the control and within the grant of the state, and generally the rule is that the first user is entitled to the enjoyment. Now, the possession of the bank or water-power site over which the water is to be conveyed in order to make the power useful, gives to its owner an advantage and a certain kind of control over the use of the water power, and it is proposed that the government in dealing with its own lands should use this advantage and lease lands for power sites to those who would develop the power, and impose conditions on the leasehold with reference to the reasonableness of the rates at which the power, when transmuted, is to be furnished to the public, and forbidding the union of the particular power with a combination of others made for the purpose of monopoly by forbidding assignment of the lease save by consent of the government. Serious difficulties are

anticipated by some in such an attempt on the part of the general government, because of the sovereign control of the state over the water power in its natural condition, and the mere proprietorship of the government in the riparian lands.

It is contended that through its mere proprietary right in the site, the central government has no power to attempt to exercise police jurisdiction with reference to how the water power in a river owned and controlled by the state shall be used, and that it is a violation of the state's rights. I question the validity of this objection. The government may impose any conditions that it chooses in its lease of its own property, even though it may have the same purpose, and in effect accomplish just what the state would accomplish by the exercise of its sovereignty. There are those (and the director of the geological survey, Mr. Smith, who has given a great deal of attention to this matter, is one of them) who insist that that this matter of transmuting water power into electricity, which can be conveyed all over the country and across state lines, is a matter that ought to be retained by the general government, and that it should avail itself of the ownership of these power sites for the very purpose of coordinating in one general plan the power generated from these government-owned sites.

On the other hand, it is contended that it would relieve a complicated situation if the control of the water-power site and the control of the water were vested in the same sovereignty and ownership, viz., the states, and then were disposed of for development to private lessees under the restrictions needed to preserve the interests of the public from the extortions and abuses of monopoly. Therefore, bills have been introduced in congress providing that whenever the state authorities deem a water power useful they may apply to the government of the United States for a grant to the state of the adjacent land for a water-power site, and that this grant from the federal government to the state, shall contain a condition that the state shall never part with the title to the water-power site, or the water power, but shall lease it only for a term of years not exceeding fifty, with provisions in the lease by which the rental and the rates for which the power is furnished to the public shall be readjusted at periods less than the term of the lease, say, every ten years.

The argument is urged against this disposition of power sites that legislators and state authorities are more subject to corporate influence and control than would be the central government; in reply it is claimed that a readjustment of the terms of leasehold every ten years would secure to the public and the state just and equitable terms. Then it is said that the state authorities are better able to understand the local need and what is a fair adjustment in the particular locality than would be the authorities at Washington. It has been argued that after the

federal government parts with title to a power site it can not control the action of the state in fulfilling the conditions of the deed, to which it is answered that in the grant from the government there may be easily inserted a condition specifying the terms upon which the state may part with the temporary control of the water-power sites, and, indeed, the water power, and providing for a forfeiture of the title to the water-power sites in case the condition is not performed; and giving to the president, in case of such violation of conditions, the power to declare forfeiture and to direct proceedings to restore the central government to the ownership of the power sites with all the improvements thereon, and that these conditions may be promptly enforced and the land and plants forfeited to the general government by suit of the United States against the state, which is permissible under the constitution.

I do not express an opinion upon the controversy thus made or a preference as to the two methods of treating water-power sites. I shall submit the matter to congress and urge that one or the other of the two plans be adopted.

At the risk of wearying my audience I have attempted to state as succinctly as may be the questions of conservation as they apply to the public domain of the government, the conditions to which they apply, and the proposed solution of them. In the outset I alluded to the fact that conservation had been made to include a great deal more than what I have discussed here. Of course, as I have referred only to the public domain of the federal government I have left untouched the wide field of conservation with respect to which a heavy responsibility rests upon the states and individuals as well. But I think it of the utmost importance that after the public attention has been roused to the necessity of a change in our general policy to prevent waste and a selfish appropriation to private and corporate purposes of what should be controlled for the public benfit, those who urge conservation shall feel the necessity of making clear how conservation can be practically carried out, and shall propose specific methods and legal provisions and regulations to remedy actual adverse conditions.

I am bound to say that the time has come for a halt in general rhapsodies over conservation, making the word mean every known good in the world; for, after the public attention has been roused, such appeals are of doubtful utility, and do not direct the public to the specific course that the people should take, or have their legislators take, in order to promote the cause of conservation. The rousing of emotions on a subject like this, which has only dim outlines in the minds of the people affected, after a while ceases to be useful, and the whole movement will, if promoted on these lines, die for want of practical direction and of demonstration to the people that practical reforms are intended.

I have referred to the course of the last administration and of the present one in making withdrawals of government lands from entry under homestead and other laws and of congress in removing all doubt as to the validity of these withdrawals as a great step in the direction of practical conservation. But it is only one of two necessary steps to effect what should be our purpose. It has produced a status quo and prevented waste and irrevocable disposition of the lands until the method for their proper disposition can be formulated. But it is of the utmost importance that such withdrawals should not be regarded as the final step in the course of conservation, and that the idea should not be allowed to spread that conservation is the tying up of the natural resources of the government for indefinite withholding from use and the remission to remote generations to decide what ought to be done with these means of promoting present general human comfort and progress. For, if so, it is certain to arouse the greatest opposition to conservation as a cause, and if it were a correct expression of the purpose of conservationists it ought to arouse this opposition. Real conservation involves wise, non-wasteful use in the present generation with every possible means of preservation for succeeding generations; and though the problem to secure this end may be difficult, the burden is on the present generation promptly to solve it and not to run away from it as cowards, lest in the attempt to meet it we may make some mistake. As I have said elsewhere, the problem is how to save and how to utilize, how to conserve and still develop; for no sane person can contend that it is for the common good that nature's blessings should be stored only for unborn generations.

I beg of you, therefore, in your deliberations and in your informal discussions, when men come forward to suggest evils that the promotion of conservation is to remedy, that you invite them to point out the specific evils and the specific remedies; that you invite them to come down to details in order that their discussions may flow into channels that shall be useful rather than into periods that shall be eloquent and entertaining, without shedding real light on the subject. The people should be shown exactly what is needed in order that they make their representatives in congress and the state legislature do their intelligent bidding.

THE PALEONTOLOGIC RECORD

THE RELATION OF PALEOBOTANY TO PHYLOGENY

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THE history of plant life has been the central idea in all botanical studies from the very earliest times, whether expressed in the imperfect methods of the early German and Dutch botanists who desired simply to establish natural affinities on the basis of external resemblances, or in the ambitions of Cæsalpino to arrive at a classification of plants which should satisfy the conditions of relationship through the structure of all parts, and especially of the reproductive organs. For nearly four hundred years the external organs have been employed as the chief basis of those numerous systems of classification which have appeared from time to time. The idea that the reproductive organs and the minute interior structure of plants were of primary importance as first advocated by Cæsalpino, was for a long time lost to view, although it reappeared now and then in the works of later writers. Eventually it gained recognition and became a factor of increasing importance, until the most advanced systems are now employed involve an acceptance of both the external parts and the internal anatomy as essential factors.

From the time of Malpighi and Grew, to Goeppert and Corda, our knowledge of the interior structure of plants made great and rapid progress, and was later applied successfully by various investigators in the direction of establishing relationships. To no one are we more fully indebted for an elaboration of this idea than Williamson, whose researches into the structure of fossil plants from the Coal Measures of Great Britain, during the latter part of the last century, laid the real foundation of modern paleobotany.

In so brief a treatment as that which is now employed, it is impossible to more than touch upon some of the salient features in the relations of paleobotany to the course of phylogeny, but it is, nevertheless, worth while to give special emphasis to the now well-recognized fact that a thorough knowledge of the interior structure of the plant, and especially of the stem, leads to a more comprehensive and exact acquaintance with relationships than that of any other part. This arises from the fact that the minute anatomical details have a greater degree of stability than any other portion of the body, doubtless due to the fact that in its adjustment to the land habit, the environmental influences

present the least variable features in those factors which determine relations to mechanical stress and physiological needs.

External organs are notoriously subject to variation, even under slight alterations of surrounding conditions, within the limits of the species or even within various stages of development of the same individual. From this it is clear that organs such as leaves must be very unreliable for phylogenetic purposes. It is, unfortunately, true that much of the paleobotanical work based upon a study of such parts must be of inferior value, and the conclusions drawn will require extensive revision when the more rigid tests to be applied through a knowledge of the stem structure are brought to bear.

The value of paleobotanical evidence consists in its ultimate correlation with known types of plants, and it is obvious that all such studies should be prosecuted with direct reference to the broader requirements of plant biology. This involves a comprehensive knowledge of the history of plant life from its earliest development; that the data derived from a study of living species should be correlated with the evidence obtained from fossilized remains. Existing vegetation shows a very incomplete record of plant life as a whole. Its history as known until very recent times, and even now to a very large extent, is displayed only through the medium of detached groups, and relates chiefly to the most highly organized types. Through the perspective afforded by paleobotany, it becomes possible to not only supply missing facts, but to establish what theory has for so long a time required a satisfactory demonstration of—a more or less continuous series of phenomena from the rudimentary forms to the most advanced organisms.

Until a very recent date the Linnæan division of plant life into two great phyla, the cryptogams and the phanerogams, was the prevailing conception of the constitution of the plant kingdom. This division recognized no connection between the two great groups, but regarded them as wholly distinct in origin as in character. But the rapid advances in a knowledge of plant anatomy, developed toward the middle of the last century, and especially the remarkable and epoch-making observations of Hofmeister respecting the process of reproduction, enabled him to break down the old barriers erected by the doctrine of the constancy of species, and prove a genetic connection between the primary divisions of Linnæus. With this starting-point, the cryptogams and the phanerogams were subjected to a severe scrutiny from an entirely new point of view, with the result that each underwent a revision which led to such a rearrangement of subdivisions as to present an entirely fresh conception of their relations to one another. The logical result was finally expressed in the subdivision of the plant world into four great phyla, which, in their evolutional sequence, came to be known as I., Thallophyta; II., Bryophyta; III., Pteridophyta; IV., Spermatophyta.

Admirable as this scheme is, and scientifically acceptable as it has proved to be, it nevertheless presents certain well-recognized defects with respect to the requirements of theory, although at the time of its formulation and as late as 1899 it represented the sum of available knowledge. It was just at this time that paleobotany became available as a means of meeting those deficiencies which a knowledge of living plants could not overcome. For a long time botanists have been familiar with certain Paleozoic remains having a fern-like aspect which were generally accepted as ferns; but because of their want of direct connection with stems or fruit, there remained a serious doubt as to their real character. In the same horizons, detached fragments of stems were also observed with increasing frequency. The study of their anatomy disclosed a structure which, in some respects, was curiously like that of ferns, while in other respects it approximated to the anatomy of the higher plants as presented in some of the gymnosperms. This combination of filicinean and cycadean characters was noted by Potonié, who succeeded in correlating them and expressing their phylogenetic position in the name of a new order which he called the Cycadofilices.

There yet remained to be considered certain remarkable fruits for which no relationship has as yet been determined until, through the work of Scott, Oliver, Kidston and others, it was shown that they were of the nature of seed-bearing organs which could be correlated with the Cycadofilices. It thus became evident that there was a hitherto unknown group of plants combining the characters of ferns in their foliage and stem structure with those of primitive gymnosperms as presented in their stems and fruits. On the whole, however, these plants approached most nearly to the pteridophytes in their external features. To this new phylum, of which the Cycadofilices formed the most conspicuous member, Scott and Oliver in 1904 assigned the most appropriate name, Pteridospermæ. This result was based entirely upon paleontological evidence through comparative anatomy, and it compels us to recognize the existence of five, instead of four great phyla. The far-reaching significance of this achievement can not be overestimated. It is not only of the utmost importance as proving the general course of evolution and bringing into the realm of proved facts what had previously been a working hypothesis only, but it offers an entirely new point of departure for the botanist of the future. Attention may also be directed to one other effect. The tendency of this discovery is to coordinate, unify and strengthen all branches of botanical knowledge, bringing to us the conviction that the more extended and thorough our knowledge of the earlier forms of vegetation becomes, the more satisfactory will be our knowledge of the science as a whole; for while the example selected is probably the most important for our special purposes, the general utility of paleontological research in relation to the

history of development is enforced upon our consideration in a great many subordinate ways.

Recognizable plant remains first occur in the Silurian in the form of certain highly organized algæ, the ancestral forms of which are unknown. Nevertheless, the history of *Nematophycus* shows that in the Silurian and extending through the Devonian, members of the brown algæ directly comparable with the modern kelps, both in general character and in detailed structure, had attained to a development unknown to any of the marine algæ of to-day. Arborescent forms with stems two feet in diameter and a corresponding height lead to the inference that they not only represent the culmination of the phylum at that time, but that they must have been preceded by a long line of ancestral forms, extending far back into the earlier horizons, possibly into the Eozoic itself.

Parka decipiens from the old Red Sandstone of Scotland affords striking illustration of the very early period at which heterospory was developed among vascular plants, which, according to the evidence now available, are comparable with the genus *Marsilea* among existing types. In these remains we meet with prostrate stems often one to two inches in diameter, from which slender, upright branches are produced, bearing in turn conceptacles containing both micro- and mega-sporangia. Some of these latter further contain prothalli in various stages of development.

The earliest form of gymnosperm is that which we recognize in the genus *Cordaites* from the Devonian. The highly developed and dicotyledonous character of the stem affords abundant evidence that the ancestral type must be looked for in some remote and earlier horizon, but, taken as an isolated case, it affords no clue whatever to the origin of that particular phylum, although the subsequent course of development may be traced with considerable certainty to comparatively recent times.

The obvious conclusion to be drawn from the geological relations presented by such illustrations as those recited, is, that the evolution of even very simple forms from the most primitive plants must have called for enormously lengthy periods of time. Even the most liberal application of the law of mutation would fail to adequately account for the extensive gaps which are recognized as occurring between the simpler types and those which lie in the same general line of succession, but with greatly advanced organization.

We are now led to ask, how far have paleontological studies carried us in our knowledge of plant life from the earliest times, that is, do they enable us to trace an unbroken series of steps from the first to the last? To this the answer must be that, while paleobotany has been of the greatest service in supplying missing data, in filling great gaps in a supposed sequence and in giving the fullest support to the law of evo-

lution, it is as yet by no means adequate with respect to meeting all that theory demands. For this there is an intelligible explanation based in part upon the fact that the necessary material is available only under conditions of great difficulty; and that the character of the remains upon which research is based is conditioned by the original nature of the structure and its ability to survive in an unaltered form, the remarkable conditions of decay, infiltration, compression, upheaval and often of volcanic influences to which it has been subjected. The earliest type of vegetation was that which we now find in hot springs, continued with the algæ found in cool or cold waters, all of which possessed a delicacy of structure which permitted speedy decay. The great abundance of such organisms probably afford an adequate explanation of the Laurentian and later forms of graphite which is regarded by many as the remains of former vegetation. While this hypothesis may be accepted provisionally, paleobotany is nevertheless wholly unable to furnish any clue to the life history of the individuals, or even to inform us as to the specific types. Such knowledge as we possess in this direction is the result of inference from parallel conditions and structures as now found.

It might be assumed that with an increasing perfection in the preservation of fossil remains, as found especially in the later formations, it should be possible to trace the course of descent with accuracy and completeness. This is, in a measure, true, but although the general requirements of theory may be verified, yet the haphazard conditions involved in the collection of plant remains make it a very difficult matter to secure a complete narrative, and there remain many gaps which it is difficult to fill. The evolutional position of the Bryophytes demands that the origin of these plants should lie somewhere in the early Silurian or even in the Eozoic age, but we have no certain knowledge of them until the middle Mesozoic, and their remains do not become familiar or abundant until the later Tertiary. So important a deviation from what theory demands should lead us to caution in drawing conclusions from the direct testimony which is thus presented. Unless otherwise disposed of through paleontological evidence, it would be more correct to infer that the delicacy of the plants, and the conditions of their fossilization, have not admitted of their preservation in a recognizable condition; while there is also the further probability that many of their remains have been overlooked through resemblance to certain Pteridophyta for which they might well be mistaken.

In spite of such apparent contradictions, the evidence everywhere points with great force to the idea that each of the lesser phyla had its origin in some ancestral form, followed by growth and culmination. This latter was, in some cases, abrupt, as in many of the Pteridophytes; in other instances there was a gradual decline, as in the lycopods or the horsetails, which attained their highest development in the later Paleo-

zoic, but have since been in a state of degeneracy, their present representatives being few in number and of a depauperate character. The application of this law throughout the enormously lengthy periods required for the evolution of existing species, has led to the survival of some of the most ancient types until the present day; to the absolute obliteration of others which at one time gained great prominence; and to the gradual dying out of yet others, some of which are now found in the last stages of their existence. But through the entire course of change, the evolution of higher and yet higher forms has been the most conspicuous fact. Furthermore, it is undoubtedly true that the general course of evolution is in progress to-day as in the past, since all the potentialities of such evolution exist now as always, though conditioned by the fact that owing to continued changes in the physical character of the earth's atmosphere as well as of its crust, the possibilities of evolution are steadily diminishing and will eventually cease.

There is one direction in which paleobotany gives well-defined assurance that the evidence derived from existing species leads to correct conclusions. In tracing the succession of types, we are led to the belief that there is no direct sequence. Conterminous evolution is in accord with neither theory nor ascertained facts, and it is, therefore, impossible to conceive of a figure which shall in any way represent a single and unbroken line of succession. If paleontology teaches us anything, it is that each great phylum, as well as its various subdivisions, finally reaches its culmination in a terminal member from which no further evolution is possible. But that from some inferior member, possessing high potentialities, a side line of development arises. There is thus, in the early life of each member of the series, a certain recapitulation of ancestral characters. This conception of a continuance of the main line of descent through a succession of lateral members is both logical and fully in accord with the evidence derived from both recent and extinct forms of plant life, as well as with our present theory of evolution.

PALEONTOLOGY AND ISOLATION

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THE notion of isolation as a factor in variation, as I am using the term, is that of geographic separation exclusively, the conception expressed most clearly by Wallace, Moritz Wagner and Jordan. I take it that while this influence has been carefully estimated in the geographical distribution of living species, it has not often been expressed in its own terms in the analysis of extinct faunas. With increasing accuracy in the record of ancient continental lines and bar-

riers, we are coming to a point where the efficiency of this factor can be safely taken into account. The outcome of free interbreeding, as Jordan has pointed out, is to unify species and obliterate variations. *Per contra,* isolation checks this process and gives freer play to tendencies arising from other factors in variation. The effect is thus, as a general rule, negative, but expresses itself freely enough in geographic provinces severed by some barrier or condition which has the effect of a barrier. Among existing species the formative effects of segregation have been very largely illustrated from restricted areas such as the subdivisional valleys and forests of Hawaii with its distinctive forms of the Helicidæ and other terrestrial snails—a case that is paralleled in paleontology by the snails of Steinheim. But the effect is to be reckoned with in larger or continental areas between which there has been at one time opportunity of interchange, especially in the case of marine species, with which we chiefly deal, along the epicontinents.

I have particularly in mind phenomena which have been brought to my notice by a somewhat extended study of the Devonian faunas of the southern hemisphere and the broader application of the factor is best enforced and illustrated by this instance. I may say that this broader notion seems to be that entertained by Darwin so far as he specified the conception of geographic segregation as an element in natural selection and it was his work in South America that formed the basis of his conclusions.

With other students we recognize the existence during the Devonian of austral continental lands which have been variously designated and variously outlined. By some this land has been posited as a north and south Atlantis lying in the meridional axis of the present ocean, by others a broken land mass partly crossing the southern Atlantic from east to west. But now we begin to see its continuity and the extent of its strands, with something of its changes in outline during its early history. It was the precursor and the nucleus of Gondwána-land. With it began, so far as we now know, the long history of that continental land and the successive records of life developing under continued conditions of geographic isolation from the northern strands.

From Argentina, Bolivia and northern Brazil we have very lucid evidence, on the basis of paleontology, that in the late Silurian the shore lines were continuous with those of the north. We have no dependable knowledge of these earlier faunas at the east and indeed their entire absence is indicated by stratigraphy; but with the submergence of the Silurian at the west, there entered from the African east upon this south Atlantic field, a positive diastrophism whose axis was well nigh normal to that of the present Atlantis, and along the shores of this growing land bridge entered an invasion of marine life

at the opening of the Devonian time. It seems to have come westward from a dispersion area in Africa and it evidently disseminated itself without interruption of continuity from the strands which now, as the Bokkeveld beds of Cape Colony, constitute the only evidence of marine life in the South African Paleozoic, to those of the Falkland Islands, two far distant regions which have much more of organic content in eommon than do the Falklands and the nearer regions of Paraná, Argentina and Bolivia.

This fauna with its special and peculiar features is, however, spread through Bolivia, western Argentina, southern Brazil, including Paraná and as far north as Matto Grosso, thence eastward by way of the Falklands to South Africa. From the boreal strands of the period it was separated by a barrier, often narrow and constituted only of deeper water, so that of the boreal Devonian we find no evidence much south of the equator in Brazil nor of the austral Devonian north of that line. This barrier I believe to have been overpassed at times during the early part of the Devonian by species which are of wider distribution south and north but these passages seem to have become rarer as time passed and as more complete geographic isolation was effected.

There are many evidences in this southern fauna that the land bridge was accompanied by insular strands which are evidenced by varying percentages in community of species and by bathymetrical variations. Apart from these possible island masses, there was clearly a Devonian land bridge extending from South Africa to the Falklands, westward into Argentina and northward into Bolivia, embracing also as continental or island lands parts of the states of Paraná, Matto Grosso and even of Pará.

By virtue of the evident derivation of the fauna of this time from the east along newly forming strands which were, throughout the period of the Devonian, kept asunder from the Atlantic-European lands at the north, and by its further development under conditions of isolation, the fauna presents fundamental contrasts to any development of the Devonian elsewhere in the world. It is in itself a unit and a unit also in relation to the sediments in which it is involved. There is no earlier Devonian in this southern region nor is there any later Devonian, for wherever the succession has been determined this austral fauna, bearing no evidence in itself of a later time stamp than early Devonian, is overlain by Carboniferous deposits without demonstrated unconformities between. Deposits and faunas which at the north we are accustomed to regard as of later Devonian age, are absent at the south, either because this austral land was broadly above the sea during these stages and its strands now lie buried or, as seems much more probable, this sedimentation represents the total Devonian sedimentation and this fauna the total Devonian fauna at the south.

I can not in this place analyze the peculiarities which give the austral fauna of these "Falklandia" strands their special impress but I may specially cite the trilobites which are astonishingly developed. I presume any competent student of northern faunas, being shown a series of these without knowledge of their origin, would pronounce them of early Devonian age and yet they are neither northern species nor, in any large degree, northern genera. While they bear the impress of boreal genera and resort to morphologic equivalencies thereto in fugitive epidermal structures which so richly characterize the boreal trilobites at this time, they are on the whole constructed on a series of modified types which hold their fundamental expression while developing minor details with the chronology normal to their succession at the north. The *Phacopes* are seldom true *Phacopes,* the *Dalmanites* seldom true *Dalmanites,* yet the same structural decorations and extravagances we are familiar with at the north, are distributed freely through the group. This is all equally true, in qualifying terms, of the other groups of this fauna, save for the fact that in these we can hardly venture to insist so entirely on generic distinctions south and north. The species differences declare themselves on every hand and taken as a whole the fauna presents fairly conclusive evidence of having derived its distinctiveness through its isolation from the boreal fauna from which it ancestrally took origin. Yet while it has developed this character it has also proceeded to maintain a faunal composition which declares its age, and a morphological stamp which shows that it developed all its parts in the proper time and place in the series.

In predicating geographic isolation as the prime factor in this regional development of the Devonian fauna, its efficiency should not be made to seem qualified by an illustration which is striking by virtue of its contrast with the already well known. There are evidences in plenty that geographic isolation has played a similar rôle with even more diverse effect in the development of the boreal faunas of the same geologic stage. The north Atlantic land bridge was continuous at this time, as evidenced not alone by the presence of the Coblentzian fauna in the Atlantic coast rocks but by an array of additional facts; and it seems very probable that the primary movement of these northern faunas was from the same African dispersion area as that of the south.

THE RÔLE OF HYBRIDIZATION IN PLANT BREEDING[1]

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THE word hybridization has been used with many meanings. The term is used here to denote the crossing of any two plants that differ from each other in a heritable character, whether they are of the same or of different species.

There is intimate connection between the rôle of hybridization and the rôle played by selection. It comes about in this way. Inherited variations are produced by nature with considerable profusion. New characters appear and old characters are lost: these form the working basis of selection. But whether they are large or small they are usually inherited completely. They are the units of heredity; or, if they are sometimes transmitted in units of lesser degree, they may be compared to chemical radicals.

The main object of hybridization then is the shuffling of these units in the first hybrid generation and their recombination in the next generation. There are, however, various phenomena attending hybridization, and I will endeavor to illustrate the following as those of most importance: (*a*) Recombination of characters and their fixation, (*b*) production of desirable combinations in the first hybrid generation and their continuation by asexual propagation, (*c*) production of fixed first generation hybrids, (*d*) production of blends.

If we begin at the real beginning in this discussion, we must say a few words concerning the actual mechanical operations of crossing. The first foundation stone to be laid is a knowledge of the flowering habits and flower structure of the plants to be used. Of course a careful examination of the flowers will show the easiest and surest method of removing the stamens of the flowers that are to be pollinated and of protecting them from foreign pollen. What is not so easily determined are the precise conditions under which the cross should be made to be successful. The proper preparation of the breeding plot even before the plants are grown is necessary. One takes it for granted that some fertilizer will be used, for the plants must be normal to seed well. The three essential elements of soil fertility are nitrogen, potassium and phosphorus, and to get the best results compounds of these elements must be present in proper proportions. First, available potash must be

[1] This paper is based on one of a series of popular lectures delivered at the Bussey Institution of Harvard University, April and May, 1910.

present in normal quantity although a certain excess will not be harmful. If nitrates are present in excess, however, vegetative growth will be over stimulated and seed production will be small. A lack of phosphates will produce the same effect upon seed production, but for a different reason. Phosphorus is an essential constituent of the proteid compounds found in large quantities in the seed. Therefore, if the plants are to be in the best condition for crossing, the soil should contain just the right amount of nitrates for normal growth and a generous supply of potash and phosphates. The exact amounts must be determined by experience for each soil and each species of plant.

Other necessary knowledge that can be obtained only from experience is which are the best flowers on the plant to serve as parents of the cross and what is the proper time for their pollination. For example, in the grasses the first flowers that appear usually form larger, healthier seed than the later blossoms. In most of the Solanaceæ, the petunias, browallias, etc., the exact opposite is true. The time when the individual flower is most receptive to pollen is even more narrowly limited. Both premature and delayed pollination is the cause of many failures and the optimum time should be accurately determined. Having exercised these precautions, it remains to study carefully the structure of the flower in order that it may be emasculated—*i. e.,* the anthers removed before the pollen is shed—with sufficient adroitness that neither the anthers shall be opened nor the parts of the pistil injured. Only a few buds upon a single flower spike should be operated upon if they are to be given the best chance of development. If the buds are very small and some pollen unavoidably reaches them, it may be washed off with comparative safety with a dental syringe if done immediately. It is often recommended that the calyx and corolla be cut away when emasculating. This should be avoided if possible and the floral envelopes left as a protection to the pistil. After emasculation the buds should be protected from foreign pollen until time for pollination, and again after pollination at least until the fruits have begun to form. This protection may be an ordinary paper bag when the crossing is done in the field. In the greenhouse I find that a square of thin celluloid rolled around the flower and caught with two rubber bands, each end being protected with absorbent cotton plugs, is a better device. It gives excellent protection and allows transpiration.

But enough of the technique of hybridizing; the phenomena attending it are of more importance. After the pollen is placed upon the stigma it begins to grow until it reaches the ovule. Down this tube comes the male cell which contains the potentialities of its parent plant. This cell fuses with the female cell in the ovule and fertilization is accomplished. From this combination the seed and later the hybrid plant results, half of its characters coming from the plant which fur-

nished the pollen and half from the plant to which it has been applied. If one studies the characters of several such hybrids, he finds many surprising facts. It usually makes no difference which plant is the mother plant, the result is the same. Certain characters are found in the hybrid that are identical with those possessed by the male parent and other characters the same as those possessed by the female parent. Other characters appear to have resulted from the blending of those of the two parents, while still others appear to be entirely new. The plant may be sterile if the cross is between widely differing species, but if it is fertile and the flower of the hybrid is self-fertilized, the plants resulting from this seed present still more surprises. For example, if one has crossed a pear-shaped yellow tomato with a round red tomato, in the second hybrid generation he will find individual plants bearing fruit of four kinds, pear-shaped yellow and round red, as were the two parents, and in addition pear-shaped red and round yellow. In other words all possible combinations occur and in definite proportions. Stated as a principle it may be said that where either of the parent plants possesses characters absent from the other, the potential characters remain pure in the germ cells of the hybrid and recombine as if by chance. This is the most important feature of the only law of heredity of which there is any exact knowledge—the law of Mendel. Let us illustrate the action of the law. Such a character as starchiness, as shown in "flint" maize, is either present or it is not present. The flinty appearance of the seed is due to the possession of some character that causes the maturation of plump starch grains. When this character is absent, the seeds dry up without maturing their starch grains, and present the wrinkled appearance common to sweet maize. Pairs of characters such as these, affecting a certain plant structure, are called contrasted or allelomorphic pairs. When a sweet maize is crossed with a flint maize, the resulting seeds are all flint like. That is, the dominant character or the character that calls for the presence of the structure or compound in question, manifests itself in the first hybrid generation. Complete dominance, however, is not a general phenomenon in crosses and as its importance is slight as compared with the second law, that of segregation of the pure characters (potentially) in the germ cells of the hybrid, we will discuss it no further. The second law predicts that in the generations succeeding a cross, plants grown from the self-fertilized seeds of the hybrid reproduce both contrasted characters in the proportion of three of the dominant or "presence" characters to one of the recessive or absent character. Furthermore, inbred or self-fertilized plants bearing the recessive character continue ever after to breed true, while of those plants bearing the dominant character one third are pure and breed true while two thirds are hybrids and again throw the recessive character in one fourth of their offspring.

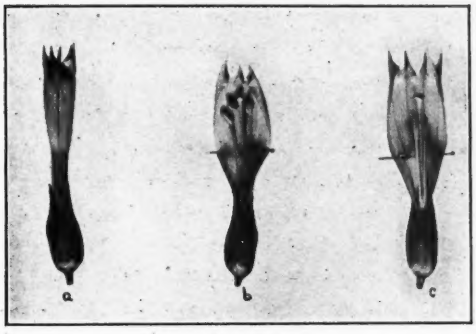

FIG. 1. CASTRATION OF BUDS OF *Nicotiana tabacum* BEFORE CROSSING. *a*, correct stage for castration; *b*, method of slitting the corolla; *c*, castrated bud.

The theory supposes that when a dominant and a recessive character meet in a cross, the germ cells which are produced in the hybrid do not blend these characters, but possess either the one or the other; and as the possession of either character is a matter of chance, on the average 50 per cent. will bear the dominant and 50 per cent. will bear the recessive character. In a plant, for example, 50 per cent. of the pollen cells would bear the dominant and the other 50 per cent. would

FIG. 2. CASTRATED BUD OF *Impatiens sultani* SHOWING METHOD OF PROTECTION IN GREENHOUSE WORK.

bear the recessive character. One half of the egg cells, likewise, contain the dominant, and one half the recessive character.

Now, if we could pick out at random any one hundred pollen or male cells to fertilize any one hundred egg or female cells, we can see that there are equal chances for four results. A dominant male cell might meet a dominant female cell, a dominant male cell a recessive female cell, a recessive male cell a dominant female cell, and a recessive male cell a recessive female cell.

We have (D + D), (D + R), (R + D), and (R + R) plants formed in equal quantities, but as the two middle terms are the same, we can reduce the formula to one (D + D) to two (D + R) to one (R + R). But wherever there is a D present in the germ cell, the

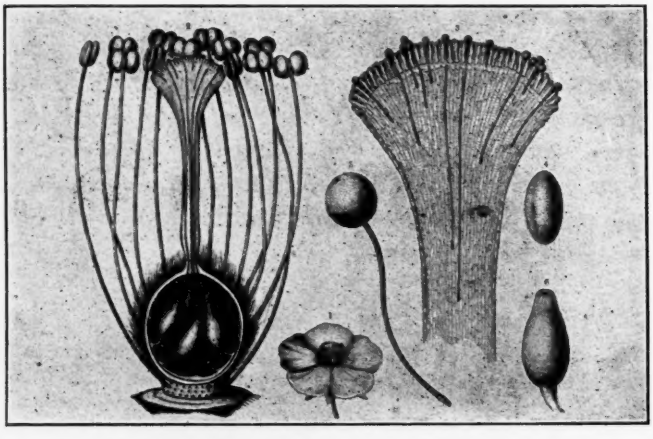

FIG. 3. THE COURSE OF THE POLLEN-TUBE IN A ROCK-ROSE (*Helianthemum marifolium*). After Kerner and Oliver. 1, single flower; 2, essential organs of flower: course of pollen tubes shown diagrammatically; 3, pollen tubes penetrating the tissue of the pistil; 4, dried pollen grain; 5, pollen grain germinating; 6, ovule.

dominant character shows, while the recessive character is hidden. The one part or 25 per cent. of the individuals showing the character (D + D) will appear just like the two parts or 50 per cent. of the individuals having the character (D + R). Therefore, there will be 75 per cent. of the individuals which will show the dominant or D character, while 25 per cent. will show the recessive or R character. These 25 per cent. showing the R character will ever after breed true, because they contain nothing but the recessive character; while of the 75 per cent. showing the dominant character, one third or those having the pure (D + D) character will breed true in succeeding generations, while the other two thirds having the (D + R) or hybrid character will again split in the next generation.

For all practical purposes in plant breeding the mere fact of segregation is of greatest importance and the complexity of recent Mendelian

interpretations need not bother us. Suffice it to say that most plant breeders have accepted the explanation that the recessive character is simply the lack or absence of the character in question, while the dominant character is its presence. This is simply a slightly different interpretation of the same facts and simplifies some of the more complex results of crossing. Instead of 50 per cent. of the germ cells bearing the flint character and 50 per cent. bearing the sweet character when sweet corn is crossed with flint corn, one should think of all of the germ cells bearing the ability to produce the wrinkled sweet corn seeds, but that 50 per cent. of them contain in addition the presence of a flint or starch producing character. In other words, the "starchy" character is superimposed upon the "sweet" character. The dominant and recessive characters in such a cross, then, are simply the presence and absence of the starchy character.

When several character pairs differentiate the two parent plants in a cross, all possible recombinations are formed, the relative frequency with which the combinations occur being simply the algebraic product of as many of the simple ratios as there are character pairs.

The importance of these Mendelian facts to the commercial plant breeder is great. In crossing plants differing in several simple characters that segregate after hybridization he may rest assured of two things. First, that with a sufficient number of progeny in the second hybrid generation, every possible recombination of the characters present will be represented by at least one *pure* specimen. Second, that these pure specimens when selfed, or pollinated with their own pollen, will breed true. It should be remembered, however, that one may have to self a number of plants to get the combination desired with all characters pure, for if any dominant characters are concerned, their purity can be ascertained only by breeding for another generation. As an illustration we may take the snap dragon, Antirrhinum. There is a long series of colors that segregate. There is also a type called the "Delilah," where the tube of the corolla is uncolored. Starting with this form in only one color, the whole color series of Delilah forms may be reproduced by crossing with the self colored strains. Or, one may combine the dwarf habit of growth of the Dwarf Champion tomato, with any of the various colors and shapes now on the market which have the ordinary tall habit of growth. Sometimes a very simple recombination is of very great commercial value. The so-called Havana type of wrapper tobacco grown in the Connecticut River valley has large leaves and a short stocky habit of growth. It produces from nineteen to twenty-one leaves. There is another type grown under cheese cloth shade which has a tall habit of growth with about twenty-six smaller leaves. The tall slender habit of growth makes it an undesirable type to grow in open fields where it is apt to be blown down. Mr.

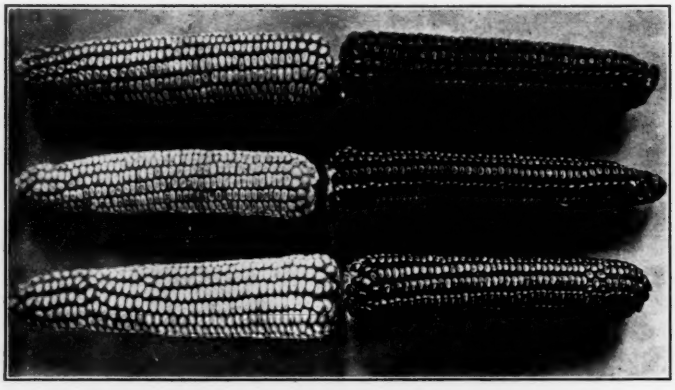

FIG. 4. SHOWING ABSOLUTE SEGREGATION IN SECOND HYBRID GENERATION. These red and white ears grew from a single self-pollinated ear of the first hybrid generation of a cross between red and white maize.

A. D. Shamel, of the United States Department of Agriculture, crossed these two types. A new type called the Halladay has been produced with the higher number of leaves of the Cuban parent and the stocky habit of growth and large leaves of the Havana parent. The first interpretation of this result was that an entirely new variation had appeared, for the Cuban type usually has but twenty-two or twenty-three leaves. The writer has been able to show, however, that the actual strain of the Cuban used as the parent of the cross has on the average twenty-six leaves, and data have now been collected that show that the new variety is a simple recombination of the characters possessed by the two parents giving an out-door type averaging thirty per cent. greater yield than the old Havana strain. In a similar way Biffen has produced a rust resistant high-yielding wheat by crossing two varieties each of which possessed but one of these desirable qualities. Orton has combined the edible quality of the watermelon with the wilt resistance of the citron, and Webber has increased the ability of the orange to resist cold by crossing with the hardy trifoliate orange.

Recent accurately controlled investigations in hybridization have shown that many apparently complex results yield to simple explana-

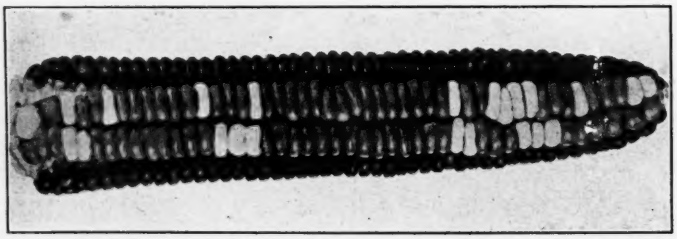

FIG. 5. RED MAIZE EAR WITH PERICARP REMOVED, showing segregation of yellow and white endosperm beneath it.

tions by use of the Mendelian theory. For example, two or more hereditary factors may be necessary for the production of an actual tangible character. If factors A and B must be present for its production, then a plant carrying only factor A and another carrying only

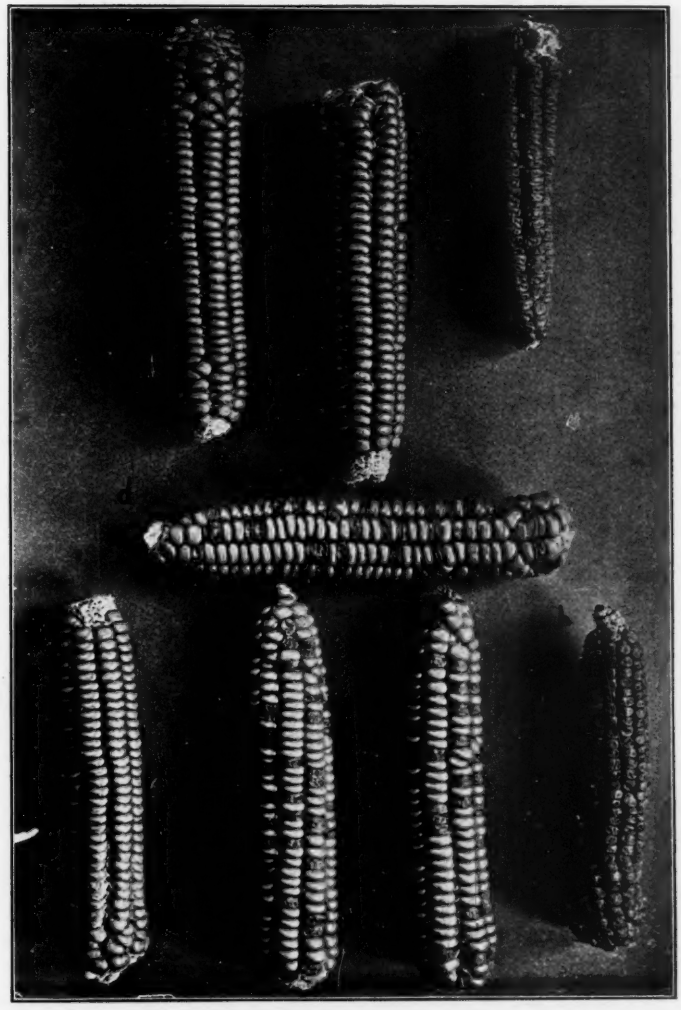

FIG. 6. MENDELIAN SEGREGATION IN MAIZE. *a* and *b*, the two parents, starchy and sweet maize; *c*, the first hybrid generation showing dominance of starchiness; *d*, the second hybrid generation showing segregation with the ratio of three starchy to one wrinkled seed. Lower row daughters of *d*. *e*, *f* and *g*, results of planting starchy seeds. One ear out of three is pure starchy. *h*, result of planting sweet seeds. Ear is pure sweet.

factor B do not possess the character. But let the two plants be crossed and the character appears. There are two white varieties of sweet peas; each, however, contains one of the two factors necessary for the pro-

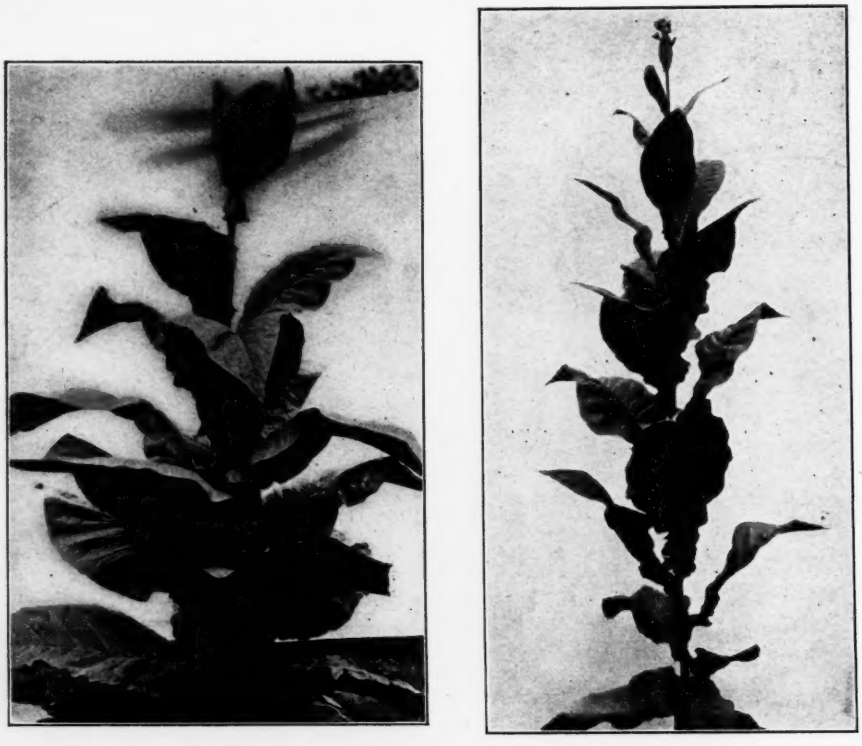

FIG. 7. AT LEFT "HAVANA" PARENT, AT RIGHT "CUBAN" PARENT OF CROSS SHOWN IN FIG. 8. The "Havana" has short habit of growth, large leaves averaging 19 to 21 in number. The "Cuban" has tall habit of growth and averages 26 medium-sized leaves.

duction of a purple variety. When these two white varieties are crossed, the purple variety results. The second generation, however, produces seven whites to every nine purples. Such segregation into purples and whites may not be desirable; all purples may be wanted. This brings us to a consideration of class B of the four classes of phenomena attending hybridization, the production of desirable character combinations in the first hybrid generation and their continuation by asexual propagation. This class really includes several distinct types of occurrences. The purple sweet pea produced from the two whites will serve as an illustration of the first type. In certain plants (not meaning the sweet pea, however) it is as simple to reproduce by cuttings as by seed. The cuttings are simply parts of the plant from which they come and are identical with it in character.[2] If in a species of this kind a desirable character is formed by the union of two or more hereditary factors and one wishes to reproduce the character indefinitely, asexual reproduction by cutting serves the purpose admirably.

[2] There are certain cases like variegation that are exceptions to this rule.

There is another case of a different kind. Sometimes the hybrid character is different from the character of the parents, even though the exact parental characters are reproduced by segregation in succeeding generations. The commercial carnation form is the result of crossing the single carnation with the huge worthless doubles called "busters." Reproduced by seed the commercial carnation throws both singles and busters, showing that segregation of the parental characters takes place; but as these plants are easily reproduced by cuttings, and the cuttings are all of the commercial type, sexual reproduction is only resorted to for the sake of producing new varieties. Another common phenomenon attending hybridization is sterility. Many very beautiful flowers produce no seed at all. This is even an advantage in some cases, because the plants flower more profusely than if they were spending their energies in the production of seed. Here again, cuttings are resorted to to reproduce the hybrid, or, as in the case of seedless oranges, the cuttings are grafted into an older rootstock instead of being rooted.

I stated at the beginning that there were two other classes of hybridization phenomena, the production of fixed first-generation hybrids and the production of blend hybrids. It is probable in the last analysis that the true explanation of these cases is the same; so we will consider them together. It is believed by many that there are kinds of inheritance other than Mendelian, that is, inheritance where no segregation occurs. Far be it from me to deny this; *I simply state the fact that there are no exact data extant proving other kinds of inheritance.* Such data may be found, but it is useless to speculate upon other laws without such evidence. There are several cases in which either new characters that breed true or blended characters that breed true *appear* to have been formed, but they have not been studied with sufficient care for an analysis of their mode of inheritance to be accurate and final. It is in crosses between true species that hybrids have been formed seemingly as constant and uniform as their parent species. Janczewsky has produced several such hybrids. Perhaps the most famous, however, are the blackberry-raspberry crosses first produced by the late E. S. Carman, editor of the *Rural New-Yorker* and later by Luther Burbank and others. Several hybrids having a commercial value have been made in this genus (*Rubus*), and all of them reproduce approximately true from seed. These are the facts and show what may sometimes be expected by hybridizers when crossing true species; but I wish to point out that this does not necessarily mean that we are dealing with a new mode of inheritance. Bramble species produce seedlings that are quite variable and in which the variations are extremely difficult to describe; there is, therefore, no exact information as to the relative variability of the hybrid seedlings as compared to that of the two parents. It may be said, then, that it is yet unknown whether there is partial segregation.

FIG. 8. FIRST HYBRID GENERATION OF CROSS BETWEEN "HAVANA" AND "CUBAN" VARIETIES OF TOBACCO SHOWN IN FIG. 7. Plant is taller than either parent showing the increased vigor due to a cross. Size of leaf of "Havana" is dominant. Habit of growth of "Cuban" is dominant. Number of leaves is intermediate, but approaches the "Cuban."

But why should there not be complete segregation to the types of each parent? In the first place, because it is likely that numerous separately heritable characters are concerned, and when *n* pairs of characters are concerned it takes four to the *n*th power seedlings to run an even chance that there will be one plant like each of the parents. When we consider that with ten pairs of characters, this means over 1,000,000 individuals, we can see with what enormous numbers one has to deal. In the second place these hybrids are only partially fertile, and as I have suggested in former papers, some consideration must be given the fact that there may be selective fertilization that works against ex-

FIG. 9. RECOMBINATION OF CHARACTERS OF PLANTS SHOWN IN FIG. 7, occurring in the second hybrid generation. This is a uniform and constant type having the short habit of growth and large leaves of the "Havana" parent, combined with the high number of leaves of the "Cuban" parent. It is now grown in the Connecticut River valley and yields 40 per cent. more than the Havana type.

treme segregation. To take a hypothetical case, suppose two plants are crossed in which the flowers of one are twice as long as the flowers of the other and that this extra length is controlled by three or four separately heritable factors. If only a few of the egg cells can be fertilized on account of dissimilarity from the pollen cells, one would expect only those seeds to be formed that would come from the fusion of the germ cells nearest alike. Intermediates would therefore be more likely to be formed than extremes. There is one other possible way of accounting

FIG. 10. SEGREGATION OF SIZE CHARACTERS. At left *Nicotiana rustica brazilia.* This plant was crossed with *N. rustica scabra* shown at left in Fig. 11. At right is a segregate of the second hybrid generation which is exactly like its parent. Unfortunately it has branched at the base or the similarity would be more striking.

FIG. 11. SEGREGATION IN SIZE CHARACTERS. At left *Nicotiana rustica scabra.* This plant was crossed with *N. rustica brazilia* shown at left in Fig. 10. At right is a segregate of the second hybrid generation exactly like its parent in size of plant, leaf and flower and in habit of growth.

for constant intermediate hybrid races which I think has never before been mentioned. In crossing species of the genus Nicotiana, I have had plants develop from seed that have apparently been formed apogamously, that is, formed from an immature egg cell without fertilization. It is evident that this is induced by the extraordinary irritation of foreign pollen. The true hybrid plants that are formed are generally blends in the first generation. The question, then, arises: May not the difficulty of maturing sexual cells in a wide cross sometimes cause apogamous development and therefore a continued propagation of a constant and uniform race?

All but the last of these suggestions may also be pertinent in the case of varietal crosses where there is said to be a blending of characters that deal with size. I am not certain, however, that all the so-called blend hybrids might not show segregation if studied in large numbers. I have found such segregation in size characters in crosses of both maize varieties and of tobacco varieties.[3]

[3] In the writer's paper "The Rôle of Selection in Plant Breeding" in the August number of this journal, the legends for figures three and four unfortunately were interchanged in printing.

THE NATURAL HISTORY AND PHYSIOLOGY OF HIBERNATION

By ALLEN CLEGHORN, M.D.

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Introduction—Natural History

IN this most important and interesting phenomenon of nature—a truly protective phase—let us first briefly consider the natural-history side of the subject, describing how hibernation is peculiar to, and differs, in the various animals possessing this function of protective winter sleep. Then we will consider the various physiological phenomena characteristic of this torpid state. Let us first make clear the meaning of some of the terms used in connection with this condition.

The term "hibernation" is used by scientists and naturalists to signify the peculiar somnolent or torpid state in which many animals, both warm- and cold-blooded, inhabiting cold and temperate climes, pass the winter. On the other hand, in hot and dry countries, various animals pass into a similar condition during the hottest and dryest season of the year, and this state is called "æstivation."

Many of the animals which hibernate during the winter are liable to fall into a similar state at intervals during milder seasons—Dr. Marshall Hall considers the day sleep of bats as a species of hibernation and has called it "diurnation."

In man it is a question if true hibernation ever occurs—a similar condition may exist, however, but it is very rare either for a prolonged or short period. Cases of hibernation (?) in man are most frequently found in India, where some religious ascetics are stated, upon unimpeachable authority to possess the power of throwing themselves into a state closely resembling hibernation (trance?) for an indefinite period. Many curious cases have been recorded by Mr. Braid in his treatise on "Human Hibernation"; the most celebrated and best known is that of a "fakir," who, in the presence of Sir Claude Wade, the English governor, was buried alive at Lahore in 1837, was exhumed and restored to consciousness after remaining in the ground for several months, the grave being guarded and every precaution taken, in the meantime, to prevent any interference or disturbance of the body.

One of the largest groups of hibernating animals we have is that of bats—Dr. Marshall Hall claims that the bat when hibernating, practically never wakes, but when disturbed will breathe naturally,[1] for a few minutes, but will then return to its former state of quiescence.

[1] *I. e.*, as in a fully wakened state, quicker and deeper.

Earlier or later in the autumn, according to the species, the bats retire to caves and hollow trees and similar places, where they cluster together, hanging by their hind claws, head downward, and clinging to one another as well as to the walls of their retreat. Such masses may comprise various species, yet all species do not retire at the same time.

The noctule is seldom seen abroad later than July—while the pipistrelle may be seen flying any warm evening during the spring, summer and autumn months.[2]

Owing to the difference in the flying season of these different bats, it is only natural to suppose that the hibernation of the former species (noctule) is much deeper and longer than in the latter (pipistrelle), which may feed all the year round. Here in North America some bats may, and probably do, migrate southward to avoid the too intense cold, and among these is probably the noctule, which is the first to come and the first to go.[3] These "flitter mice"[4] are insectivorous, and before discussing some of the other mammalia, it may be advisable to call attention to some points of difference existing, during the hibernating state, between the carnivorous and herbivorous animals.

Bears come out of the hibernating condition as fat, or nearly so, as when they retired in the fall; marmots, ground squirrels, etc., emerge in poor condition, in some cases quite emaciated; this in spite of the fact that they are functionally torpid, while bears and skunks are not. Female bears even bring forth their young while hibernating and suckle them from about the beginning of February to April, while they obtain no nourishment themselves.

The bear and badger, in our northern and western climates, retire to their winter quarters and pass the greater part of their time in sleep, yet neither the brown bear[5] nor the badger falls into a true state of hibernation. On the other hand, the black bear of North America is aroused with difficulty from his winter sleep, and this gives ground for the belief that he differs from the other species of bears in that he hibernates while the others do not.

The most perfect hibernating animal we have in Canada is the ground-hog (woodchuck), which hibernates in a burrow of its own

[2] These names—noctule and pipistrelle—are the common names of two species of European bats; the genus *Pipistrelle* is represented in North America, but only in the extreme southern portion of the United States, by three species and two subspecies. The common bats of eastern North America are the hoary, brown, silvery, red and the little brown bat, all of which are found here in British Columbia except the red variety.

[3] Bats undoubtedly migrate; see Miller, "North American Fauna," No. 13.

[4] Old term.

[5] The "brown bear" is a very loose term—the cinnamon bear is only a color phase of the common black bear. The grizzly may be any color and are subgenerically distinct from the black bear. It is doubtful if any bear is completely torpid during hibernation; the grizzly is much less so than the black bear, the period of hibernation being shorter.

making. In Europe the hedge-hog[6] (an insectivorous animal) is most complete. It retires to a hole among rocks, under a tangled mass of roots of trees or sometimes into an old disused drain, there it remains for the winter, seldom or never awakens until spring, and during this time it takes no food. In Canada it wakens to eat. If disturbed, it draws a deep sononous breath, followed by a few weak respiratory movements, returning almost immediately to its deep state of torpor and quiescence. The tuerec, an allied animal, found in Madagascar, sleeps similarly in its burrow for three months during the hottest period of the year.

None of the American (or European) squirrels truly hibernate[7] except the chipmunks (Entamicæ) and the ground squirrels (spermophiles).

The dormouse hibernates in the strictest form and its torpid condition is much deeper than that of the squirrels, its favorite bed for its long slumber being an old bird's nest or a mass of dried moss or feathers. In captivity, this little animal has been known to sleep for several days during the summer. The myoxus, an allied animal, when brought to Europe from Africa, hibernated in the winter seasons as if it were its usual and natural habit, without sustaining any harm.

The hare will lie beneath deep snow for several weeks at a time, in a cavity just large enough to contain its body. In a similar manner, sheep, without any apparent injury, have been known to live for several weeks, buried in huge snow drifts or slides.

All the amphibia hibernate in cold and temperate climes. Land tortoises bury themselves in holes in the ground, while the fresh-water tortoises bury themselves in the mud at the bottom and sides of lakes and ponds. They obtain a deeper condition of torpidity than that of hibernating mammals, digestion and respiration (lung) being entirely suspended. Frogs hibernate in masses in the mud at the bottom of stagnant pools and if awakened from the hibernating state by warmth, can remain underwater, without drowning, considerably longer than they can during the breeding season. That frogs (toads?) can remain in a state of hibernation for an indefinite period remains to be proved, but too many circumstantial accounts have been reported of the discovery of live toads in masses of solid coal or rock formations to allow the idea to be dismissed as fabulous.[8]

Reptiles, fish and batrachians exhibit little change from their usual

[6] Hedge-hog; this term hedge-hog is confusing; it is the term applied in Maine and New Brunswick to the common porcupine.

[7] In Canada, both the porcupine and squirrel store up food for winter consumption, rousing themselves at irregular intervals to eat.

[8] "Our common toad hibernates in the ground, as does the wood frog (*Rana sylvaticus*) and the small jumping frogs (*Hyla*). Our newts also hibernate in the ground."—John Burroughs (private communication).

condition (?). Lizards and snakes retire to holes in trees, under stones, dead leaves, and many species may congregate together in large numbers. They are in a quiescent and somnolent state, not true hibernation.

Fish of the temperate zone do not fall into a state of complete torpidity, but their vital functions are diminished and they retire to sheltered holes and cease to go abroad in search of food. In the tropics (Africa and India) large numbers of fish are known to survive long and severe droughts during which the streams and ponds are completely dried up. This, they do, by passing the dry season embedded in the mud.

Most of the species of molluscæ hibernate. The land snails bury themselves in the ground or conceal themselves under the bark of trees; in fact in almost any sort of a cavity to be found. They close the mouth of their shells with a calcareous plate technically known as the "epiphragm," and this is perforated by a minute hole to permit breathing. The substance forming this plate they secrete in their mouths. During the dry weather in summer, the snails bury themselves in the ground and cover the opening of their shells with this protective shield, but it is much thinner than the one used in winter. This they do to protect themselves from the drought, *i. e.*, by checking evaporation. Slugs bury themselves but do not enter into a complete state of hibernation. Fresh-water molluscæ go into a state of hibernation in the fall, burying themselves in the mud until spring. It is believed that salt-water molluscæ hibernate in a similar manner, but practically nothing is known concerning them.

Many butterflies and moths hibernate in the perfect state as well as in the form of imagos, but not in the larval state (?). Most insects which pass the winter in a state of larvæ hibernate during the period when they can not obtain any food. Insects which hibernate do not pair until spring and bees do not hibernate at all. It is well known to bee-keepers that these insects need plenty of food during the winter months.

In the seeds of plants and in the eggs of many of the lower animals, life may remain dormant for years in cold climates, until heat or moisture awakens them. Many plants die down, while their roots remain alive during the winter season (perennials and biennials), coming to foliage and blossom in the spring. In the same way trees shed their leaves in the autumn and the sap returns to the roots. Similar phenomena take place in tropical countries during the hot season, whenever the amount of humidity in the atmosphere is sufficient to maintain perennial vegetation during the entire year.

These phenomena in the vegetable world are regarded generally as being analogous to those of hibernation in animals and therefore the terms "hibernation of plants" is sometimes applied to them.

Physiology

In this article, so far, we have dealt with the natural-history side of hibernation, explained what is meant by the various terms used in connection with this state and in what respect the condition itself differs in the various animals subject to its peculiar manifestations: a condition provided by nature to tide an animal over a period when its very existence, owing to scarcity of food, becomes too difficult or even impossible to maintain; so by preserving the animal's life allows it to perpetuate its species.

We will now pass on to consider the purely physiological phases and phenomena of this state.

In hibernation all the activities of the body are greatly reduced, the temperature of the animal is lowered and even falls to a point slightly above that of the surrounding media. As it has been pointed out above, animals which hibernate do not belong to any one class, but examples are met with in mammals, reptiles (?), amphibians, insects, molluscæ, but curiously enough, no case is known among birds.

In some cases, previous to entering the hibernating state, the animal stores up food in its den or nest, on which it feeds when it wakes at intervals during its winter sleep. This is hardly pure hibernation, as in the true cases there is a special accumulation of fat in the animal's body before the commencement of the torpid state (the animal not waking to feed) and this serves as food during the hibernating period. A peculiar physiological change is here involved—a herbivorous animal becomes carnivorous, this being caused by the animal living on its own flesh, hence the excretions (small) of the animal become profoundly and completely altered in their chemical characters.

A low temperature is the cause generally assigned for the production of hibernation, but a more careful consideration of the facts long ago showed that cold could not be the sole cause of the phenomenon. Most observers who have worked on the subject have found that extreme cold will not cause an active animal to hibernate; although Saissy has observed that continued cold, and a limited amount of air for respiration caused a marmot to pass into a typical hibernating condition, even in summer. Against this we have Vernon Bailey's experiments with spermophiles (first cousins of the marmots or ground-hogs), which showed that in the case of hibernating animals a few degrees lower temperature changed the torpid state into one of death.

Mangili found that torpid marmots and bats were awakened by exposure to severe cold and that lessened or confined air would not cause hibernation. Dormice have been kept in a warm room throughout the winter and yet they hibernated and were not aroused when the extreme temperature was 20° C. The warmth, however, delayed the onset of torpidity by two months and made it less profound. Again, as has been mentioned before, hibernation may take place in the dry hot season.

The supply of food may also be a factor producing this condition, as torpidity in dormice and groundhogs is delayed or prevented when the food supply is plentiful. I question this for the following reasons: Spermophiles and marmots retire for their winter sleep when their food supply is at its best; they only remain active until the full coating of fat is acquired. Here in British Columbia they will retire a month or more earlier in the low lands than they do at the timber line. In the latter regions they have not acquired enough fat until the end of September, as they come out of hibernation later in the spring.

In this connection it is interesting to note the influence of the food supply on man, protectively causing a condition closely resembling hibernation. For instance, there is in Russia a certain class of peasants who suffer from a chronic state of famine which becomes more acute at the end of the year and more or less severe according to circumstances. In these cases, when the head of the family sees, towards the end of autumn, that by a normal consumption of their supply of wheat it will not last the family through the winter, he makes arrangements to diminish the rations as much as possible. Knowing that it will be difficult to preserve their health and keep up the physical force necessary for their work in the spring, he and his family plunge themselves into a condition known as "lejka" which means that everybody simply goes to bed, lying down on the top of the flat stove, and there they stay during the four or five months of winter. They get up, during this time, only to replenish the fire, eat a small piece of black bread and take a small drink of water. The peasant and his family try to move as little as possible and sleep as much as they can—stretched out on the stove top, they preserve almost complete immobility. Their only care during the long winter is to keep down the body metabolism, to waste as little as possible of their animal heat, and for that reason they try to eat and drink less, move less, and to generally reduce the activities of their bodies. Their instinct commands them to sleep as much as possible—obscurity and silence reign in the hut where, in the warmest place, either singly or crowded, the occupants pass the winter season in a condition closely resembling hibernation.

The following observations are purely physiological phenomena, occurring in mammals only.

Respiration

The frequency of respiration is greatly diminished, the rhythm is irregular and often of the Cheyne-Stokes type.[9] What little respira-

[9] In the Cheyne-Stokes type of respiration, there is a pause in the respiratory act, then a small respiration occurs, to be followed by a deeper one; then a still deeper act and so on until the maximum is reached, when the respirations begin to gradually diminish until they die away altogether. This is followed by a prolonged pause, then they gradually begin again.

tion (*i. e.*, interchange of gases in the lungs) there is, when the thoracic muscles and diaphragm are not acting (*i. e.*, complete cessation of movement) is maintained principally by the "cardio-pneumatic" movement.[10] A hibernating dormouse may not give a single respiration for ten minutes, then takes from ten to fifteen breaths, at the end of which it again lapses into a state of quiescence for a period of several minutes, when the spasmodic respiratory act again occurs. The same animal, when in a normal waking state, breathes at the rate of eighty or more respirations a minute. Similar results are obtained in other animals. It has been observed that hibernating bats and marmots could be kept for hours in an atmosphere of carbon dioxide gas, without suffering any ill effects, whereas a bird or rat placed in the same chamber died almost at once, thus showing that in the hibernating state the consumption of oxygen is extremely small or in other words very little oxygen is required by the hibernating animal (owing to the quiescence and lowered metabolism of the animal and naturally for the same reasons very little carbon dioxide is given off). Saissy has observed that the amount of oxygen taken in by a dormouse varied according to the activity of the animal, and so in true hibernation the amount of the intake of oxygen is naturally very small.

Circulation

During hibernation, the force and frequency of the heart-beat is greatly reduced. In the case of the bat and dormouse, it is as low as fourteen or sixteen per minute, while in these animals in the active state it is one hundred and over. Hill and Pembry by applying a stethescope to the chest of a hibernating bat, make the observation that no sound of the heart-beat could be heard, I can confirm this observation as applying to the hibernating ground-hog in British Columbia, also, whereas with the animal awake and active, the sounds were so loud that they could be heard distinctly when the ear was an inch away from the animal.

I have found, and can confirm other observers, that the blood during hibernation has an arterial hue (bright red) in the veins, and, on the other hand, Marshall Hall states that it has a venous color in the arteries.

Digestion

The activities of the digestive organs vary according to the habits of the different animals. Some, much as the dormouse, marmot (?) and hamster, store up food in the autumn which they consume during the winter in their waking intervals. Naturally, then, their digestive

[10] Cardio-pneumatic movement. Here the visible movements of respiration, dilation and contraction of the thorax, have ceased, but still air (a very small amount) is drawn into and expelled from the lungs. This is due to the heart's action, it also being contained in the thoracic cavity, hence its contraction and dilation so alters the pressure in the thorax that an interchange of respiratory gases is produced in the lungs.

organs are intermittently active. In the black bear, however, digestion is completely suspended and his intestines become plugged up with an indigestible mass composed chiefly of pine leaves. This mass is not discharged until the bear wakes in the spring.

It may be well to note here the important part played by the liver during hibernation in maintaining the animal's life; it acts as a storehouse, storing up energy in the form of glycogen, often called animal starch—a substance derived principally from starchy or carbohydrate food. This glycogen is converted in the liver into sugar and poured into the circulation, which carries it to the tissues, where it is consumed during hibernation, as well as in the waking state. The presence of glycogen in the liver-cells of the frog and other animals may actually be seen by the aid of the microscope, immediately before hibernation, and its absence, more or less complete, at the end of this period, demonstrated in the same manner. (This is disputed by Weinland and Richl —they claim that the amount of glycogen in the body remains constant during hibernation.

Nervous System

The excitability of the whole nervous system is greatly depressed. Physiologically, it resembles, as do the other tissues, that of cold-blooded animals in general, in that all the tissues (muscular, particularly) retain their excitability for a long time after they are removed from the body.

Temperature

A warm-blooded animal during hibernation loses all control (reflex) over its temperature-regulating mechanism, and acquires all the characteristics of a cold-blooded organism, that is, instead of its body having a regular, normal and steady temperature, its temperature becomes about the same as the surrounding media, and as this rises or falls, so does that of the animal. On the other hand, by arousing a dormant animal from its stupor, it is possible to make it exercise enough to bring its temperature up to normal, *i. e.*, what it would be in its ordinary walking and active circumstances, or in other words to bring it back to warm-blooded conditions again.

On studying the changes in external temperature, we find that the output of carbon dioxide and the temperature vary with the activity of the animal. If the animal is very active, it responds to a fall in external temperature by more muscular activity, and by this way maintains the normal heat of its body. If, however, this animal is in a sleeping condition and there is a sudden fall in temperature, it somewhat arouses at first, becomes active, and this causes an increase in the output of carbon dioxide, but after a few minutes it coils itself up again and returns to its former somnolent condition, and from which it is not so readily aroused. It has also been observed that when the surrounding temperature has been raised, the temperature of the

hibernating animal does not keep much above it, until a point is reached when the animal wakens. Then its temperature rushes up many degrees in a few minutes and at the same time the excretion of carbon dioxide becomes enormously increased.

Immunity and Formation of Antitoxine

Hansmann describes the influence of temperature on the incubation period and the formation of antitoxine. He found much greater resistance to infection and lengthened incubation time and no production of the various antibodies during hibernation. Blanchard and Blatin made the observation that in the hibernating condition the marmot was immune to parasitic maladies.

Conclusion

It may be stated and accepted that when hibernation has been fully investigated, all degrees of cessation of functional activity of the various organs and tissues will be found represented, from the normal sleep of man and other animals to the lowest degree of activity manifested in life. Though some observers claim that in true hibernation there is complete cessation of function in some organs, as, for example, the lungs and movements of respiration, this is extremely doubtful. The awakening of an animal from its winter sleep is never sudden, but slow and gradual, often lasting for hours. This gradation from a passive to an active condition is no doubt protective to the vital machinery, as it has been noticed that when bats have been awakened suddenly they have quickly died.

We have spoken of hibernation in man, and by some authorities, sleep in man is closely allied to a state of hibernation. Natural daily sleep is favored by moderate exhaustion, the cravings of hunger being satisfied, and the absence of all peripheral stimuli. Sleep is a rhythmic diminution of the activities of all the tissues, but especially of the nervous system, which has control of all the others. As we have mentioned before, Marshall Hall and others have shown that the gaseous interchange in a hibernating animal is greatly lessened and so too it is in sleep. It has also been shown by experiments that hibernation, like daily sleep, is not a series of fixed and rigid phenomena, but is varied in depth and in season and its main use is that of protecting and conserving life.

All forms of profound winter and summer sleep are protective, both of the individual and of the species. If it were not for this act of hibernation, many of the mammalia, amphibia, as well as some other groups of animals, would be utterly destroyed from the face of the earth.

THE HOME OF THE ALLIGATOR

By Professor A. M. REESE
UNIVERSITY OF WEST VIRGINIA

IT has twice been my privilege to visit the wilds of Florida under the auspices of scientific societies, the first trip being to the Everglades, while the second expedition, under the auspices of the Smithsonian Institution, took me to the flat-wood and prairie regions in the center of the state, far from railroads and other signs of civilization.

From the pleasant little town of Orlando, with its orange groves and numerous small lakes, we plunged almost immediately into the "piney-woods," where the road is scarcely more than a trail, and is strewn with numberless huge pine cones that produce constant and nerve-racking jolting to passing vehicles.

For about thirty miles we drove, slowly on account of heavy loads, through the pines, where but few and widely separated houses, and no villages, worthy of the name, were to be seen. The monotony and loneliness of these almost perfectly level forests, broken only by an occasional cypress swamp, sluggish stream, or tiny cabin, becomes, to one accustomed to a thickly-settled, rolling country, quite oppressive; and we were glad to come suddenly to the edge of the forest where we could look out for miles upon the open prairie. The prairie proved to be much more interesting, though no less lonely, than the pine woods. The ground is here covered with either grass, upon which large herds of cattle feed, or with the "scrub palmetto" which is, apparently, gradually spreading its useless foliage over the entire prairie.

These scrub palmettoes, especially where they grow in taller, denser groups, are the home of numerous diamond rattle-snakes, the most deadly of American reptiles. As we drove past the palmettoes we frequently saw, and always captured alive if possible, these deadly rattlers, my guide being very expert and perfectly fearless in handling them. If they were coiled when found, he would simply reach out his hand slowly and pick them up by the back of the neck, sometimes attracting their attention by dangling a handkerchief in front of their eyes with one hand while he seized them with the other. If they attempted to escape, he would tap them with a carriage whip until he made them crawl where he could get at them easily. It is remarkable the amount of teasing and rough handling to which a rattler will submit without attempting to bite. His rattle may whirr violently and

A Typical Florida "Hammock."

The Interior of a Florida "Hammock."

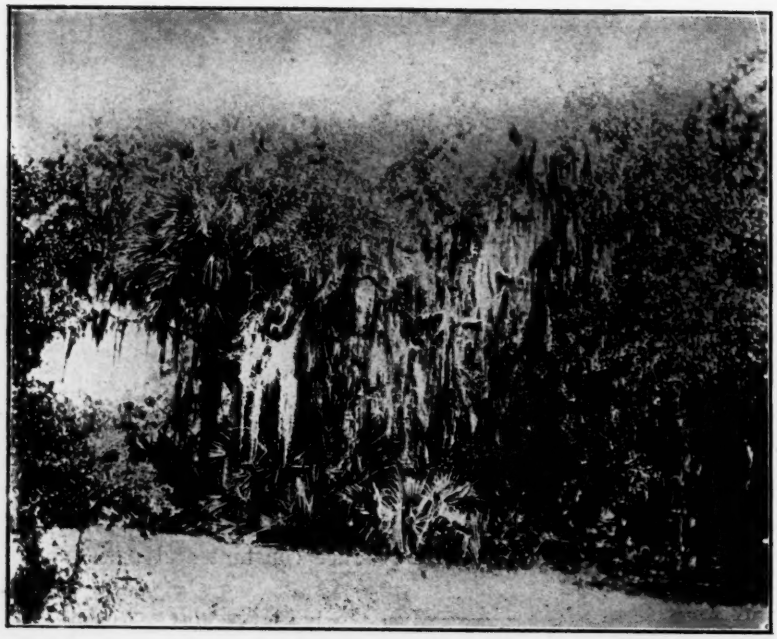
he will look as threatening and deadly as any animal could, but, unless he be shedding, he will seldom strike if he can avoid it by escaping from his tormentors.

Although he had been handling and collecting snakes for thirty years, my guide had, until this trip, never been bitten by a rattler. One morning he had caught, in a noose at the end of a pole, a large rattler that was shedding and was, therefore, very vicious. Where a snake was lying in an inaccessible place, or was, as in this case, unusually

LEAVES OF THE "CABBAGE PALMETTO."

vicious, a noose was generally used and the snake thus transferred to a bag carried for the purpose. As he was being lowered into the bag, this particular snake gave a sudden twist and one of his poison fangs cut a long gash in the hand of his captor. Fortunately for the man, only the extreme tip of the fang penetrated the skin, so that little or no poison was injected. The guide always carried a hypodermic syringe for just such emergencies, so that a dose of potasium permanganate was soon injected into the wound, and no ill effects from the bite were felt.

Although the bite of these rattlers is not necessarily fatal to man, almost any one in that region can tell of one or more cases where death has followed within a few hours of the time that the wound was inflicted.



A TYPICAL FLORIDA "HAMMOCK."

THE INTERIOR OF A FLORIDA "HAMMOCK."

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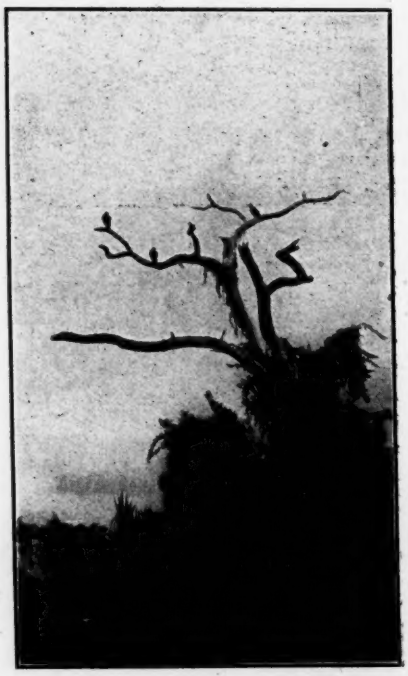
CAPTURING A DIAMOND RATTLER.

villages would be in other states: Camp Hammock, Hickory Hammock and Jack Hammock are familiar names in that region. They serve as camping places for men, and as shelters from the noonday sun for cattle. Some of them, when entered, are veritable fairy-lands: from the branches of the huge live oaks are festooned great masses of beautiful, gray, hanging moss, while here and there is stationed a stately palmetto, with its great head of green leaves, each leaf nearly twice as tall as a man. From the lower growth may project the gaunt, bare branches of a dead oak, on which a group of turkey-buzzards and carrion crows are likely to be seen.

The much smaller ground rattlers are also numerous on the prairie, but, on account of their small size, one to two feet instead of six to eight, they are not feared as are the diamond rattlers.

The monotony of the prairie is broken by an occasional clump of trees, known as a "hammock" (probably derived from "hummock"). These hammocks are sometimes composed merely of a small group of palm trees, called "cabbage palmettoes" from the edible, cabbage-like core at the tip; or they may cover several acres and contain moss-hung oaks and a dense undergrowth. The hammocks serve as landmarks and milestones for the traveler and cowboy, and many of them are named, just as streams, hills or



A GROUP OF CARRION CROWS.

Except for the flatness of the country, which makes the drainage uncomfortably slow in wet weather, a more delightful place to pitch one's tent could hardly be found than one of these Florida hammocks. To be sure there are numerous snakes (we caught no less than twenty-three in a hammock where we camped for about a month), but they are mostly of harmless varieties and are really very graceful and interesting animals.

Dotted over the prairie are numerous small swamps and sluggish water-courses: the latter are called "sloughs" (pronounced "slews"), and differ from the former in containing, at least during wet seasons, running water. These swamps and sloughs are the home of the alligator and the deadly cotton-mouth moccasin. While searching for the

A Typical 'Gator Hole of Central Florida.

nests of the former, the latter were frequently seen, but were left severely alone, as they are quite deadly, are much more aggressive than the rattlers, and have no warning rattle to indicate the state of their tempers.

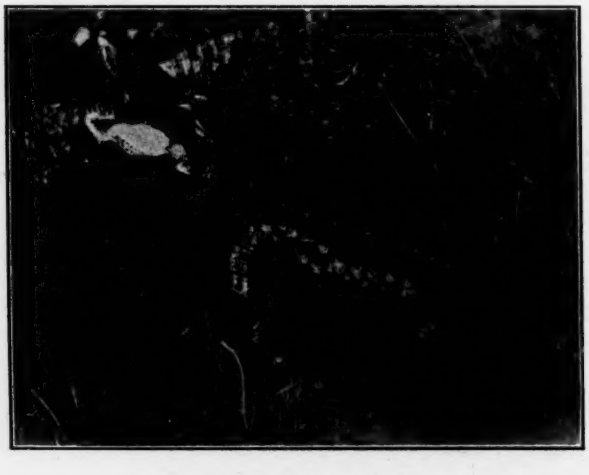
In these swamps we collected not only several hundred alligator eggs, but also numerous alligators themselves, both large and small. The baby 'gators were hooked up out of the water with a wire noose on the end of a bamboo pole, while the large ones were either shot directly or were pulled out of their caves under the banks and killed by a rifle bullet in the back of the neck.

A NEST OF THE FLORIDA ALLIGATOR, made of a mass of flags and grasses. The nest has been opened to show the pile of eggs within.

In the tall grass about the swamps deer are frequently seen, while on other parts of the prairie wild cats, skunks and other animals are met with; and rabbits are so abundant and so tame that they may be killed with a long pole or snared with the noose used for capturing young alligators.

Herons, cranes, ibis and other beautiful and interesting birds are constantly seen, so that the naturalist has something of interest before his eyes at every turn.

For the ornithologist, professional or amateur, who wishes to study and photograph an interesting bird colony, as has been done by Chapman with the flamingoes and by other naturalists, there is, on a small



AN EIGHT-FOOT FLORIDA ALLIGATOR.

FOUR NESTS OF THE WHITE IBIS, within a radius of three feet, on Bird Island. Several nestlings, which are black at this age, are to be seen.

island near the center of Lake Kissimmee, an excellent opportunity. Lake Kissimmee, which is about thirty miles long by five wide, lies at almost the exact geographical center of the state of Florida. It may be reached by driving, as in the present case, or by motor-boat from the town of Kissimmee on the Atlantic Coast Line Railroad, at the head of Lake Tohopekaliga.

The island in question is well named "Bird Island," for it is the nesting place of thousands of white ibis, and not a few other birds. Its situation in the center of the lake makes it a safe retreat from the wild-cats and other destructive animals of the mainland, while the neighboring swamps furnish an endless supply of food for both old and young birds. For miles in all directions flocks of ibis, from three or four to as many dozens in number, may be seen feeding in the swamps and sloughs, or flying, single file, with their characteristic alternate flapping and sailing, to and from the rookery on the island.

The island itself is covered with a dense jungle of reeds and undergrowth, with areas of bushes and small trees. When one pushes through the reeds into one of the bushy areas, there is a startling whirr of wings as thousands of the ibis take to flight, circling about overhead in a perfect cloud, and making a most beautiful spectacle.

At the time of our visit to the rookery, about the middle of July,

nesting was in full swing, and in all stages, from the egg to the nearly full-grown bird. The nests, crude affairs, each made of a handful of small sticks, were everywhere—in every available situation on the bushes and small trees, and scattered over the ground in such numbers that one had to walk with care to avoid stepping on them. In some nests were eggs, as has been said, while in others were birds of all sizes, the larger of which scrambled away awkwardly at our approach. With a proper shelter it should be an easy matter to get any number of photographs, at closest range, of these interesting birds. Circling overhead was a flock of crows, watching for opportunities to swoop down, in the absence of the parents, and carry off the young birds from the nests.

A HERON POSING FOR HIS PICTURE. The Bird Island Rookery, Lake Kissimmee, Florida.

For studying reptiles and birds there is probably no more interesting locality in the United States than this subtropical region of central Florida; and if the ubiquitous gun sportsman can be kept away, the hunter with the camera may there enjoy his harmless and instructive sport for many years to come.

The writer will be glad to furnish information as to equipment, guides, etc., to any camera sportsman who may be interested; powder-and-shot sportsmen need not apply.

THE OWEN BILL FOR THE ESTABLISHMENT OF A FEDERAL DEPARTMENT OF HEALTH, AND ITS OPPONENTS

By S. ADOLPHUS KNOPF, M.D.

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ANY one who is familiar with the workings of governmental departments of health such as exist abroad, who has seen or experienced the sanitary benefits bestowed upon the people by the Reichsgesundheitsamt of Germany (imperial department of health), the Conseil Superieur de Santé Publique de France, and the similar institutions of most European governments, can not help feeling amazed that any opposition should exist to the establishment of a federal department of health in this country. This amazement becomes all the greater when one considers some of the elements of which the opposition to that measure is composed. There is, for example, the New York *Herald,* a large and influential newspaper with an honorable career and a brilliant record for advocating everything that is conducive to the public welfare. Only in this particular instance has it allowed itself to become the mouthpiece of principles to which it is in general opposed, that is to say, principles and measures whereby the good of the people at large and the progress and welfare of mankind are hindered, and the lives of individual American citizens endangered. This particular newspaper is independent of any political party, or professional or religious association which might prejudice its point of view, and still it opposes a measure whereby all citizens of the country would benefit. The writer can not help thinking that this powerful news organ has not informed itself thoroughly of the real purpose and function of a federal department of health, and in its attack upon a large body of men such as compose the American Medical Association, the American Public Health Association, the National Association for the Study and Prevention of Tuberculosis, the American Association for the Advancement of Science and the various medical academies of the country, it is certainly misguided. It is to be hoped that the distinguished editors of the New York *Herald* will soon see that in their attitude toward the Owen bill they are not on the side of the people but are working against the welfare and interests of the masses.

The principle of the Owen bill, establishing a department of health, has been endorsed by the president of the United States, by General George M. Sternberg, surgeon-general of the army, retired, and Rear-

Admiral Charles F. Stokes, surgeon-general of the navy, by General Walter Wyman, of the Public Health and Marine Hospital Service, by Dr. Harvey W. Wiley, of the bureau of chemistry, by governors of states, by the Conference of State and Territorial Boards of Health, by the United Mine Workers of America, by the National Grange, by the republican and democratic platforms, and by numerous other organizations.

What is the principle of this bill which is advocated by thousands of men trained in medicine or sanitary science and interested in the public welfare?

Section 7, which embodies the main purpose of the Owen bill, reads as follows: "That it shall be the duty and province of such a department of public health to supervise all matters within the control of the federal government relating to public health and to diseases of animal life."

Section 2 of this bill deals with the unification under a secretary of public health of the various agencies now existing which affect the medical, surgical, biological or sanitary service.

There has recently been formed an organization which calls itself "The National League for Medical Freedom." It has for its purpose to combat the Owen bill; it is opposed to the establishment of a federal department or bureau of health. The name of this organization is certainly, if not intentionally, misleading. It can not claim to battle for medical freedom, for there is not a word in the entire bill which could be interpreted as limiting the practise of medicine to any particular school. Their claim that the establishment of such a bureau of health would have any resemblance to a medical trust is entirely unfounded.

The life insurance and industrial insurance companies which advocate this bill certainly have no desire to limit medical freedom or to repress any system which offers the chance of lengthening human life. These companies do not favor medical partisanship and their sole interest is to prolong the lives of their policy-holders by whatever means possible. Their actuaries state specifically that they believe human life could and would be lengthened by the establishment of a federal department of health.

Lee K. Frankel, Ph.D., representing the Metropolitan Life Insurance Company, is a member of the Committee of One Hundred, appointed by the American Association for the Advancement of Science to further the propaganda for the establishment of such a department. Neither the above-mentioned great newspaper nor any of the leading spirits of the "National League for Medical Freedom," all of whom, I regret to say, have allowed themselves to ascribe the worst motives to the members of the committee, will deny that the names of the officers

of this committee show that it is thoroughly representative of the highest type of American citizenship. The officers of the Committee of One Hundred are:

President: Irving Fisher, Ph.D., professor of political economy at Yale University.

Secretary: Edward T. Devine, Ph.D., LL.D., professor of social economy, Columbia University, and secretary of the New York Charity Organization Society.

Vice-presidents: Rev. Lyman Abbott, D.D., LL.D., emeritus pastor of Plymouth Church, editor of *The Outlook;* Jane Addams, A.M., LL.D., founder and head worker of the Hull House Settlement, ex-president of the National Conference of Charities and Correction; Felix Adler, Ph.D., professor of political and social ethics, Columbia University, leader of the N. Y. Society for Ethical Culture; James B. Angell, A.M., LL.D., professor of modern languages and literature and president emeritus of the University of Michigan; Joseph H. Choate, LL.D., D.C.L. (Oxford), diplomat and United States senator; Charles W. Eliot, A.M., LL.D., president emeritus of Harvard University; Rt. Rev. John Ireland, LL.D., archbishop of St. Paul; Ben. B. Lindsey, judge, reformer and author, Denver, Colo.; John Mitchell, president of the labor union of America; William H. Welch, M.D., LL.D., professor of pathological anatomy, Johns Hopkins University.

Need I say anything in defense of the Committee of One Hundred after having given the names of its officers?

Direct and most unkind comments, not to use a stronger term, have been directed especially against one vice-president of the committee representing the medical profession. I refer to Dr. William H. Welch, M.D., LL.D., president of the American Medical Association. Those who know Dr. Welch and even those who only know of him, would justly think it absurd if I should see the need to say even a word in defense of this master of medical science. To us it is indeed difficult to understand that there would be any man or woman in this land capable of speaking ill of Dr. Welch. There is no name in the medical world which is more honored in this country and abroad, no medical teacher more admired, no one who has a larger following than this Johns Hopkins professor of pathology, and no physician more beloved and looked up to as representing all that is best and noblest in the profession than Dr. Welch. If there is any man in the American medical profession who is unselfishly devoting his high intelligence, his time and his means to the public welfare it is Dr. Welch. Gladly do we acknowledge him as our leader.

To accuse the president and members of the American Medical Association of selfish motives in advocating the establishment of a federal department of health is absurd. If there ever was an unselfish

movement inaugurated, it is this one. It is a movement by physicians for the reduction of disease, which *ipso facto* means a movement against their financial interests.

The writer is a member of the regular profession; he nevertheless would not wish for a moment to limit the freedom of any citizen to choose his physician from some other school or cult, providing the individual assuming the function and responsibilities of a physician had the training necessary to prevent him from endangering the life of his patient by lack of medical knowledge or skill.

The official mouthpiece of this "National League for Medical Freedom" is Mr. B. O. Flower, who has had heretofore the reputation of a fighter for everything involving the spiritual, social and physical progress of humanity, and it is inexplicable to many of his admirers how he can lead a movement opposed to the improvement of the health of the nation. The vast majority in the ranks of this so-called "league," though they may be well-meaning, noble, and earnest, are not men and women who have toiled patiently for years in order to acquire the thorough scientific medical training which enables one to assume that great responsibility of the care and treatment of the sick. They are unable to appreciate the inestimable value of federal help in preventing disease. These people are blindly following certain individuals who designate the regular profession as a medical trust, and accuse the thousands of noble men and women who are devoting their lives to the alleviation of human ills of a desire to monopolize medical practise. The establishment of a federal department of health would mean pure food, pure medicine, control of plagues and epidemics, the advancement of medical science and through it the improvement of the health and increase of material wealth of the nation. It is said that many of the individuals opposing the Owen bill are commercially interested in the manufacture of drugs or patent medicines, of which latter the American people swallow about $200,000,000 worth annually. Whether it is true or not that the National League for Medical Freedom is backed financially by drug manufacturers and patent medicine concerns, I am not prepared to say; yet even these men have nothing to fear from a federal department of health if the drugs they put on the market are pure and the claims made for patent medicines do not delude the public or endanger its health. The element which clamors most loudly for medical freedom is composed in many instances of men and women who have attended one or two courses of lectures or got their "degrees" without any training at all, and have developed into "doctors" and "healers" in a most remarkably short space of time.

Because the American Medical Association has always advocated a thorough medical education, is pleading constantly for pure drugs, is opposed to quackery, patent medicines and nostrums, its 40,000 mem-

bers are considered a medical trust. Yet it is in the ranks of this very American Medical Association that are found the greatest number of unselfish devotees to preventive and curative medicine. It is within this association that are found the men who have added the greatest glory to the medical and scientific reputation of this country. America's greatest surgeons—Marion Simms, Gross, Sayer, O'Dwyer, Bull—were members of this association. McBurney, Jacobi, Stephen Smith, Welch, Osler and Trudeau have graced this association by their membership for nearly half a century. The heroes in the combat against yellow fever—Reed, Lazare and the hundred of others who have devoted their best energies and knowledge and often sacrificed their lives for the sake of medical science—were members of the American Medical Association.

One of the most illustrious members of the American Medical Association is its former president, Col. William C. Gorgas, of the U. S. Army, chief sanitary officer at Panama, an adherent to the regular school. It is thanks to the genius, the scientific and thorough medical training of Dr. Gorgas that the formerly deadly Isthmus of Panama has now become as sanitary a region as any. A great patriotic enterprise, important to commerce and the welfare of nations, was made possible by this man. He has labored and is constantly laboring for the establishment of a federal department of health because he knows the inestimable benefit which such a department would bestow upon the nation.

Whatever advance has been made in medical science in America or in Europe has been made by scientifically trained men or by physicians not without but within the ranks of the regular profession. The greatest benefactors of mankind are those who diminish disease by prevention and cure. As another illustrious example of medical benefactors, may I be permitted to cite that great trinity of scientific giants who through their labors have accomplished so much in reducing disease and lessening human misery in all parts of the globe? They are Pasteur of France, Lister of England and Koch of Germany; all of them aided their governments by direct participation in the governmental health departments. We are still mourning the death of perhaps the greatest of the three—Robert Koch. I do not believe that there is, even in the camp of our opponents in this so wrongly called "League for Medical Freedom," a single intelligent individual who will deny the inestimable benefits which Koch has bestowed upon mankind through his discovery of the germs of tuberculosis, of cholera, of the spores of anthrax, of tuberculin, and through his many other equally important scientific labors. Yet, had it not been for the Imperial German Reichsgesundheitsamt, which is the equivalent of the institution we are striving for—a federal department of health—Koch

never would have been able to devote his life, energy and great genius to those important discoveries through which thousands of lives have been saved in all civilized countries during the past few decades. It was while working in this governmental institution, which is doing exactly the work the Owen bill asks the federal department to do, that Koch discovered the tubercle bacillus and the bacillus of cholera. Because of the discovery of the comma bacillus, we no longer have those fearful cholera epidemics which formerly decimated our own and other countries. This disease can now be easily diagnosed and by proper quarantine its mortality can be reduced to a minimum. And what shall we say of the progress that has been made in the fight against tuberculosis because the federal department of health of Germany enabled Koch to do research work and thus discover the bacillus of tuberculosis to be the primary and only direct cause of the disease? As director of the hygienic institute and member of the Reichsgesundheitsamt he inaugurated that wonderfully effective campaign against tuberculosis whereby the mortality from this disease in Germany has been reduced to nearly one half of what it was prior to the discovery of the tubercle bacillus.

Under Koch's inspiration and guidance and in the same institute many great scientific discoveries of incalculable value to humanity were made. Foremost among them are the works of Ehrlich, one of Koch's most celebrated pupils, who recently gave to the world a new remedy which promises to prove a specific in an affliction from which mankind has suffered for centuries.

As co-worker in the Kaiserliche Gesundheitsamt and the Institute for Infectious Diseases, affiliated therewith, we must also mention Behring, the discoverer of the anti-diphtheritic serum. Thanks to the discovery of this serum thousands of young lives are now saved which would formerly have fallen victims to the terrible disease known as malignant diphtheria. This was made possible by the opportunity given to the workers in the Reichsgesundheitsamt and Imperial Institute for Infectious Diseases.

Can there be any better argument in favor of the establishment of a federal department of health?

THE DISTINCTION BETWEEN THE LIBERAL AND THE TECHNICAL IN EDUCATION

By Professor PERCY HUGHES
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THE terms liberal and technical do not distinguish two types of educational practise, but two tendencies in and functions of any part of the educational process. For at the present time any type of liberal education includes of necessity education for efficiency in some art, in the broadest sense of that term; while the existent types of technical education involve training that goes far to realize liberal ideals.

But, in any education, the tendency to emphasize the technical at the cost of the liberal function of that education is confronted with the reciprocal striving of the liberal tendency and ideal to maintain its ancient eminence and prerogative. The technical aim is to fit the individual to take his place in the social scheme of toil through efficiency in some art, whether it be teaching or engineering, medicine or "business." The liberal purpose is the realization in each individual of the highest manhood, of those ideals of character and personality which alone make the toil and sacrifice of society meaningful and worth while. It is possible that these two tendencies should cooperate and indeed proceed along identical lines of educational effort now, as they have done in times past. But it seems that under modern conditions which the school can neither at once change nor at all afford to disregard, the demand for technical efficiency is necessarily antagonistic to liberal aspiration—not indeed at all points, but in many respects.

I believe that it is of the greatest importance clearly to formulate and contrast these two tendencies in modern education, so that, in answer to the perfectly clear and exceedingly insistent demands for technical efficiency, there may be set forth ideals of liberal education which shall be well understood by all interested in education, and shall appeal to all as imperative and urgent.

Disregarding, therefore, accidental, partial and temporary phases of liberal education, we note, in the first place, that in styling an education liberal we thereby associate it with liberalism in politics, in philosophy and theology, and in men's personal relations to each other. In each case liberalism seems fundamentally to denote freedom, that is, the conditions that make for the development and realization in each individual of that character and personality which is his true nature. A similar argument leads to the conclusion that the technical in educa-

tion is directed toward efficiency in some art. (Here the term art is used in its original and broadest sense, to include any method of action that is recognized and adopted as the means appropriate to achieve some definite, specific purpose.) We may then conclude that an education is liberal in so far as it makes for manhood and personality, technical in so far as it makes for efficiency in some art. And we proceed to consider why it is that at the present time we find the liberal opposed to and contrasted with the technical trend of education.

In ancient Athens the aim set before each citizen was, fundamentally, to be a good citizen; and in mastering that art he realized also personality and manhood. Here the technical and the liberal in education seemed in perfect accord. And it was so in the Rome of Cicero and Quintilian, when the education of the orator was looked on as the fullest development of personality. And, in primitive and medieval Christianity, the fullest realization of the soul in that life-long education which should bring salvation in the knowledge and love of God was the very education which should fit the man also for the one supreme art, the extension of God's kingdom here upon earth. So too the knight, the warrior of the medieval system, could not distinguish the education which should make him a perfect knight, from that which should make him a perfect man.

During the renaissance there appeared and flourished a type of education which had in view the cultured gentleman, rather than the perfection of any art to which he might or might not apply his powers. But even here the liberal was not *contrasted* with the technical, though in later times there developed from this renaissance ideal the still persistent concept of a "gentleman" who might best attain culture when aloof from the general life of toil. But what is most noteworthy in the renaissance, whether we consider its birth in the free Italian cities, its culmination in Luther and Bacon, or its close in Milton, is not unworthily summed up in the ideal of education which Milton himself thus expressed: "I call therefore a complete and generous education that which fits a man to perform, justly, skillfully and magnanimously, all the offices both private and public of peace and war." Still then it was thought that a man might attain efficiency in every art and therein find his perfect freedom and full realization.

The sense of opposition between the liberal and the technical in education is not to be found in Huxley or in Spencer, who best express to us the scientific in contrast with the humanistic vision of liberal education. Indeed, both these men were criticized, even in their own day, for failure to see that to be "in harmony with nature" or to strive after a comprehensive knowledge of the various fields of science is not the best preparation for most occupations, and is indeed hardly possible in view of the necessity for the thorough acquaintance with some limited field of science and knowledge which modern conditions seem to demand.

For, as the development of the sciences has led to the elaboration and multiplication of the arts, and to consequent specialization in each field of art, even the gifted man finds himself forced to abandon the scientific and humanistic aspirations which have been identified with a liberal education, in order that he may attain some small success in a selected realm of practical art and achievement. Without for the present assuming that such specialization does indeed mean dwarfing and distorting of personality, we clearly have to recognize that it introduces a new factor into the situation, which at least tends to turn technical education from liberalizing paths, or seems to do so.

Another influence seems more obviously and directly to turn technical education from liberal ideals, viz., the fact that most arts now demand for their prosecution great sums of money. For this and for other reasons, no doubt, all arts have come to be looked on as in the first place parts of "business," and are followed and studied chiefly from the business point of view, in which the first consideration is to do that for which people will pay, and to make a profit. "Business" itself may be called an art; perhaps the art of money-making. But, while of other arts it often is true that they require of the efficient artist that he be very much of a man, no one claims, I believe, that the art of money-making "functions" very successfully in the enlargement and ennobling of personality. And, however much we may urge the student and worker in any field of art, other than that of money-making, to find within his work his reward, and to place the excellence of his art above all considerations of gain, we must admit that that view of technical pursuits is taken by but few men, save for "those brief moments when men are at their best."

Granting then the liberalizing potentiality of any technical education we may fairly inquire whether, in the presence of these two factors, extreme specialization, and the exaltation of money-making, the liberal tendency in and function of education is not greatly neglected and harassed. But in such an inquiry I would avoid the view-point of those who stand primarily as defenders of an ancient order of things, of an excellence the vision of which has bestowed upon them, but which is rarely granted to those who attain intellectual maturity under present conditions. The conception of a liberal education, that it stands for freedom, for the spontaneous realization in each individual of what in the fullest and truest sense he is, such a conception summons us to the unbiased study of the individuals born into the world as it now is, in order that we may afresh determine with their aid, for ourselves and for them, what means to adopt in order that the best in each of them may come to light. Yet, in thus adapting the liberal ideal and aspiration to present conditions, we of course reject neither the classic nor the scientific springs of culture.

It seems to me that evidence of an actual opposition between the liberal and the technical in education is found in three distinct evils which pervade the activities of society; and in each case it seems to me that the remedy for the evil lies only in adhering to and establishing the ideal of liberal education.

It is regarded as the business of the technically trained man to give people what they want, if they will pay for it. He is not expected to judge, or to be capable of judging, whether what is thus done makes for the development of human nature and personality. A shipbuilder is not expected to judge whether the object for which he builds the ship—war, it may be, or contemptible luxury—is a worthy object; the skilled advertising agent is not blamed if he collects money for the publication of a magazine much worse than useless, but permitted by law; the bridge-designer is not expected to see that his designs are executed under conditions that make for the safety and welfare of the workmen; the automobile manufacturer is not censured for the construction of machines ill adapted to run according to law, but excellently suited to break the law and to put other people to discomfort and in danger; the newspaper editor is not blamed for the destruction of acres of noble spruce trees sacrificed to the production of a "comic" supplement.

Even though we ask of the preacher and the teacher, of the physician and the scientist—yes, of the lawyer and the politician—that they have regard to the welfare of men in their several lines of art, and though such technical training as all these men may receive is not without reference to this liberal aspect of the professions they are to follow, yet we have to recognize that none of these professions is free from the general principle that people should get what they are willing to pay for, and not much else. And it must be confessed that in every line of technical education, with the partial exception of the training for teaching and the ministry, what little insistence there is upon the importance of the liberal conception of life and art, is not accompanied by thorough instruction in determining what ideals of manhood and personality are worthy and well founded. On the study of what things are of real worth much has been written (outside the literature of "revelation") which compares in solidity and scope of treatment with the best that the mathematician and the physicist have achieved in their fields of science. But the study of these teachings is at present largely neglected, and seldom systematic or continuous.

From the liberal standpoint the highest development of a man's personality involves the sense of a thoroughgoing responsibility for what he does, and the determination to decide for himself, so far as possible, whether what he does is, in its results upon human welfare, worthy of himself. No man surely is called free who acts without

appreciation of the significance of his acts. It is therefore the liberal ideal that a man must seek himself to be the first judge of his own acts, as to whether in the last analysis they are right or wrong. The conception that a man may do whatever he is paid to do, provided his acts do not come under the effective censure of the state, is no more liberal than it is lovely. It seems to be the neglect of the liberal ideal that has brought us face to face with our present condition in which talented and trained men are swifter to do evil than the will of the people is found ready to check the evil through laws.

The first element, therefore, of the liberal as distinguished from the technical function of education, at the present time, is that men trained for any art should know and fully recognize what things in life are of greatest worth, and should acquire the habit of acting according to that conception; especially in their own fields or art. While history, literature and philosophy seem to be the subject-matter through which such education may be given, it is obvious that their association with technical pursuits would need to be made much closer than is usual, if the aspect of liberalism which I have described is to be realized.

A second respect in which, I think, the liberal in education needs sharply to be contrasted with the technical drift in modern education, may be styled "appreciation." In some occupations, it is true, there is a strictly technical necessity that a man must grasp the scientific, social and esthetic significance of his task, if he is to do his work well; but in countless other lines of technical achievement, from the work of a factory hand to that of a railway president, it is idle to assert that a proper appreciation of these aspects of his work is essential to his technical success. And, indeed, it is essential that a man's appreciation of the meaning of his work should be cherished quite independently of any possibility of use and reward; though of course if the reward come, all the better. Freedom and the adequate realization of personality require that a man's work "have meaning to himself." Let him see within his work, in Dewey's words, "all that there is in it of large and human significance," and he will not be the slave of tomorrow's promised smiles.

There is no "job" that does not present innumerable phases of interest, and problems for investigation to the mind trained in physics and chemistry, none that is not linked in a hundred ways with all the problems and needs of the social organism, and with the history of man's effort and advance, his folly and despair. There is no task, I suppose, in which the eye and ear trained to appreciation may not detect features of beauty and romance and mystery. And to the philosophic mind the very monotony of the toil is linked with the tireless movement of ocean and planet, while the spirit that endures it is felt to be kin and near to the will and temper of heroes in all ages.

The habit of thus associating the richness of history, romance and science with one's daily work is found in some men, and is a source in them not only of technical efficiency, but of strength and joy. How little is such genuine liberalism fostered by the aristocratic conception of culture as a means of occupying leisure, or by our actual practise of dissociating the study of history, literature and philosophy from the common tasks of to-day! Perhaps the remedy lies partly in the introduction of industrial training into our schools, perhaps in the more common employment of teachers who have worked in shop and factory and office.

The third way in which under present conditions the liberal in education stands opposed to the technical, is in the recognition of individuality, the right of each individual to "yield," in Emerson's words, "that peculiar fruit which he was created to bear." In place of each man adjusting himself to his environment, which, technically speaking, means the present or anticipated demands of the buyer, Emerson invites the individual to "plant himself indomitably upon his instincts and there abide," for the huge world will come round to him. However exaggerated the language, the conception is fundamentally the liberal conception, viz., that the end of all our activities is nothing but the bringing to flower and fruit the highest perfection of which each man is capable. Whereas the technical view at present is to look on the individual as part of the machinery by which the "world's work" is done, that is, service is rendered for which people can be got to pay, the liberal view is to insist that the world's work is the cultivation of the garden of human life, and the best service a man can render is to offer the world the finest fruits of his own personality. Liberalism bids the man take counsel of his own spirit rather than of the market, and prophesies that in maintaining his stand in the face of the world he will gain a deeper insight of the essential harmony between himself and it, while lifting life to a higher scale of intensity and idealism.

By thus starting from the simplest possible conception of liberal education, as education for freedom, for the realization of personality, we escape from a narrow tradition, and from a false antithesis to industrial ardor and efficiency, and are left free to judge for ourselves wherein under present conditions true personality consists, to note without prejudice what evils the technical emphasis in education actually tends to nourish, and to devise under constantly changing conditions new ways for the protection and furthering of the liberal ideal. Clearly the defense of the liberal in education is not merely a matter of insisting on certain courses of study traditionally styled liberal; but, if I have correctly analyzed the situation, it is to cherish certain ideals and to train in certain habits, viz., in the evaluation of one's conduct in terms of its effect upon character, in the appreciation of the interest

and beauty that actually is present in our work, and in counting individuality, patient and prudent independence, of more significance than the world's approval or reward. Subsidiary to such ideals the classics, ancient and modern, have indeed their place, which is side by side, however, with modern science, in all its branches, and the alert observation of living men and existent things, which are at least as important instruments to such liberalism.

The reformation which thus appears necessarly would be furthered, in my opinion, by the formation in each school and university of one or more associations of instructors for the professed, deliberate and persistent study of the means through which the liberal spirit and purpose may be preserved and increased, first in themselves, second in the world at large, and finally in the student body. For liberalism can not be very effective in the curriculum until it is born again in our hearts and in the world at large. Few instructors seem to be less liberal, in the fundamental significance of the term, than many teachers of the subjects which are traditionally styled liberal. Personally, I look with most hope towards those young men who are conscious of the need without being committed by tradition and profession to any particular way of meeting the need, men, who, having their eyes fixed upon the industrial world as the place where men really live, earnestly ask themselves how the boys who are to toil there may take with them from home and school the habitual recognition that the ultimate aim of all modern industry is nothing but the exaltation of manhood, the free realization in individuals of the ideals of manhood.

THE TARIFF BOARD: ITS SCOPE AND LIMITATIONS

By SEYMOUR C. LOOMIS
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EMINENT authorities on civil government lay down the rule that certain questions should be left to the people or their representatives in a legislative body, and certain other questions should be decided by experts: the latter, not because experts do, or do not, represent the people, but because they are more familiar with the subject-matter and better able to reach a correct determination. Upon this principle our federal and state constitutions have separated the legislative from the judicial department. The legislature is chosen particularly to represent the people; the judiciary, because of its knowledge of the administration of the law.

Many, if not most, public questions arising in a republic, may properly be classified in one or the other of two ways: those which should be settled by the people, and those which are best referred for final action to men trained in the subject-matter. There are some questions, however, which can not be put wholly in one or the other of these divisions. They are similar to those issues arising in the practise of law which are mixed questions of law and of fact, as, for example, the question of negligence. The court, when a case involving negligence is before it, decides what standards the law requires and provides certain positive rules which must be obeyed by a party in order for him to be in the exercise of due care. But within those rules there are a vast number of cases which may, or may not, amount to negligence in fact, according as the jury applies the test of what an ordinarily prudent person would, or would not, do under the circumstances.

So the tariff is a question both for congress and for experts. Under our federal constitution, as well as in accordance with the unwritten principles underlying our government, the power to lay duties is vested in congress. It can not be delegated to any other person or body whatsoever. Obtaining the evidence and finding the facts so that the duty can be intelligently levied, falls within the province of experts. It is for congress to say whether a tariff should be designed primarily for protection or primarily for revenue, and to lay duties accordingly. It has no power under the constitution, and ought to have none, to frame a tariff simply for the purpose of allowing certain persons to obtain an excessive profit. Such a tariff has been called a

tariff for profit. No reasonable person would contemplate the deliberate formation of such a tariff. It has doubtless been brought about as a result of certain schedules, but was presumably unintended by the framers. It is here that legislative machinery breaks down and requires the aid of experts to furnish the foundation for intelligent action. It is conceded that congressmen have no time, even if they have the capacity and inclination, to find out and properly correlate all the intricate items of supply and demand; weigh the variations of cost of production here and abroad, and finally to estimate the relative amount of protection and revenue, which will be yielded according as the duty is more or less. A schedule which produces a large revenue may not be protective and one which is protective may produce no revenue at all. But between these extremes are numberless shifting conditions where the amounts of protection and revenue vary as the duty is higher or lower.

Previous to about a year ago these reasons did not appear to congress sufficient to justify the appointment of a permanent governmental agency to inquire and find out in regard to this subject. But the agitation surrounding the framing of the Payne tariff bill was such that congress in August, 1909, passed a law which recognizes the need of such a board. Merchants and manufacturers throughout the country were emphatic in their demand for it. The great body of manufacturers had begun to realize that their foreign as well as domestic trade was seriously damaged or ruined, for the benefit of a few industries, which were making an excessive profit.

The popular branch of congress did not at first regard this agitation as of enough importance to warrant the passage of any law concerning it. In the senate, however, the finance committee were convinced of its sincerity. Several bills for a tariff commission had been introduced. Those proposing that such a commission should have power to fix rates, even within certain limits to be prescribed by congress, overstepped the domain of a commission for the reasons already stated. Others were within the proper field. On July 3, 1909, while the Payne bill was before the senate, the finance committee reported an amendment which provided for maximum and minimum rates. The general duties in the bill were to constitute the minimum tariff, and the amendment provided that from and after March 31, 1910, there should be added to the general duties a further one of 25 per cent. ad valorem, which was to constitute the maximum rate. It was further provided that, whenever after March 31, 1910, and so long thereafter as the president shall be satisfied that any foreign country imposes no discriminations or restrictions, against the United States, either by way of rates, regulations, charges, exactions or in any other manner, directly or indirectly, upon the importation of the products

of the United States, and that such foreign country pays no export bounty or imposes no export duty or prohibition upon the export of any article to the United States, which unduly discriminates against the United States or the products thereof, and that such foreign country accords to the products of the United States reciprocal and equivalent treatment, thereupon and thereafter, upon proclamation to this effect by the president, all articles from such country shall be admitted under the terms of the minimum tariff; that is, without the addition of the 25 per cent. ad valorem. The proclamation may extend to the whole of any foreign country or may be confined to, or exclude from its effect, any dependency, colony or other political subdivision, having authority to adopt and enforce legislation, or to impose restrictions or regulations, or to grant concessions, upon the exportation or importation of articles which are, or may be, imported into the United States.

It is further provided that whenever the president shall be satisfied that the conditions which led to the issuance of the proclamation no longer exist, he shall issue a proclamation to this effect, and ninety days thereafter the provisions of the maximum tariff shall be applicable to all productions of such country, whether imported directly or otherwise into the United States.

Then the amendment in the senate closed with this important clause:

To secure information to assist the president in the discharge of his duties imposed upon him by this section, and information which shall be useful to congress in tariff legislation, and to the officers of the government in the administration of the customs laws, the president is hereby authorized to employ such persons as may be required to make thorough investigations and examinations into the production, commerce and trade of the United States and foreign countries and all conditions affecting the same.

This amendment passed the senate and went with the rest of the senate bill to the committee of conference of the senate and house. The provision in regard to the maximum and minimum tariff board clause was cut down and made to read as follows:

To secure information to assist the president in the discharge of the duties imposed upon him by this section, and the officers of the government in the administration of the customs laws, the president is hereby authorized to employ such persons as may be required.

In this form it was finally passed by both houses of congress, signed by the president and is now the law.

What are the powers of this board under this act and what further authority, if any, ought to be given to it in order to make its usefulness as effective as possible?

The purposes of the board are twofold: (1) To secure information to assist the president in the discharge of the duties imposed upon him in the maximum and minimum section. (2) To secure information

to assist the officers of the government in the administration of the customs laws.

The scope of this language is much greater than appears on its face. The president in order to be satisfied of the existence of the facts, which are the basis of his proclamation, must have accurate information of the details which go to make up the presence or absence of discrimination on the part of every foreign country which does business with the United States. If the president is not satisfied, then the provision for this immense additional duty of 25 per cent. on the total value of the imported goods, remains in effect. It does not become operative by the action of the president, but continues in force by his omission or failure to act. It is evident that there will be enormous pressure from foreign governments as well as from our own importers to see that the president takes action if he has not already done so. If he is satisfied as to one or more foreign countries, and so proclaims in accordance with the law, the United States at once is in a position to demand fair and reciprocal treatment from the others. The fact that the products of any foreign country may be imported into the United States without the payment of 25 per cent. of their value, provided the president is satisfied that such foreign country makes no discrimination against the United States, is a strong argument, not to say leverage, to induce that foreign country to remove the discrimination and reap the benefit of trade with the United States. This would also be to the advantage of our own producers and manufacturers who desire a foreign market for their products.

A differential, or maximum and minimum, tariff, applicable to countries foreign to themselves, is in force in Argentine Republic, Austria-Hungary, Belgium, Canada, Denmark, France, Germany, Greece, Italy, Japan, Norway, Russia, Spain and Switzerland. A general tariff rate applicable to all foreign countries is in force in Mexico, Netherlands, Sweden, Turkey and the United Kingdom of Great Britain and Ireland. The United States had commercial agreements under section 3 of the tariff law of 1897, with Bulgaria, France, Germany, Great Britain, Italy, Netherlands, Portugal, Spain, Switzerland and Cuba. In France changes have been and are now under consideration, making the maximum rate to range from 25 per cent. to 100 per cent. above the minimum.

A brief consideration will disclose the necessity of the president's being correctly and accurately informed as to details in order to become satisfied that a foreign country accords to the products of the United States reciprocal and equivalent treatment. And he must not only be satisfied once, but he must continue to be satisfied in order to have the minimum duties remain. The act provides that so long as the president is satisfied, etc., the articles from such country shall be admitted

under the terms of the minimum tariff, and that whenever he shall be satisfied that the conditions which led to the issuance of the proclamation no longer exist, he shall issue a proclamation to this effect and ninety days thereafter the provisions of the maximum tariff shall be applicable to all productions of such country whether imported directly or otherwise into the United States.

These duties thus cast upon the president require him to keep in constant touch with the situation, not only of the treatment which our products receive when exported to foreign countries, but also as to the action of such foreign country in respect to export bounties, duties and prohibitions upon the export of any article to the United States, and its effect upon the United States and its products. There are many ways by which a country can indirectly discriminate against another country or its products. One way is to raise the valuation as appears on the invoice or bill of lading. This may result in the payment of a larger ad valorem duty or a higher specific one on account of a different classification. If such treatment is unfair, and is persisted in against the products of a particular country, and not pursued against those of other countries, the treatment is discriminatory. The value of the article exported then becomes of prime importance, for if the value stated on the invoice or bill of lading is less than it ought to be, perhaps so made with the intention of saving duty, then the foreign customs officers have an equitable right to raise the valuation to a proper and reasonable amount, and such action on their part, provided they do the same with the products of all other countries, is fair and just. In order for the president to know in regard to this, he must have accurate knowledge of the cost of production of all articles exported from this country, and as any article made in the United States is likely at any time to be exported, he should also have knowledge of its cost, etc., so as to be ready to act, when the occasion arises, as provided by the act of congress. Some articles are now exported from this country at valuations less than they are sold here. Such practise is not contrary to the law of the United States, but it is contrary to the law of foreign countries to value articles for the purpose of customs lower than they are worth. What they are worth depends to some extent upon their cost in the country where they are made.

The second branch of the tariff board's duties is to secure information to assist the officers of the government in the administration of the customs laws.

What has been said of importations into foreign countries applies to importations into our own. The proper administration of our customs laws requires on the part of the various officers of our government a clear insight into the value and cost of all articles imported. The acts of congress require the general appraiser and the boards of general

appraisers to "proceed by all reasonable ways and means in their power to ascertain, estimate and determine the dutiable value of the imported merchandise, and in so doing they may exercise both judicial and inquisitorial functions." This, however, only applies to articles which are subject to an ad valorem duty or to a duty based upon or regulated in some manner by the value thereof. In such cases the act distinctly provides that the duty shall be assessed upon the actual market value or wholesale price thereof, at the time of exportation to the United States, in the principal markets of the country whence the goods are exported; and that such actual market value shall be held to be the price at which such merchandise is freely offered for sale to all purchasers in said markets, in the usual wholesale quantities, and the price which the manufacturers or owners would have received, and was willing to receive, for such merchandise when sold in the ordinary course of trade in the usual wholesale quantities. In order to determine with any degree of accuracy, the appraisers, the board of appraisers, and on appeal the government's counsel, must be in possession of the facts in detail to properly know and present the government's side of the case. When one reflects that some 300 to 400 millions of dollars are expected to be annually collected as revenue from the tariff, one realizes that there are sure to be strong tendencies, acting on the exporters of foreign countries and the importers here, to keep the valuations down to the lowest possible sum. The importers are allowed to produce witnesses and try out their cases in very much the same manner as prevails in ordinary cases before the courts of justice, with the additional authority in the board of appraisers that they have inquisitorial powers.

The tariff board can clearly be of great assistance to our various customs officers if it should continually keep informed and have in its possession facts and figures relative to the cost of foreign products, as incidental to their true value and as indicative of the price which the foreign manufacturer or owner would have received and was willing to receive, when sold in the ordinary course of trade, in the usual wholesale quantities, in the principal markets of the country, whence the goods may be exported. Such assistance would be increased when the publications of the tariff board by virtue of their accuracy, completeness and truth come to be regarded as authoritative and are accepted as such both here and in foreign countries. A condition like this would lead to better trade relations between this country and the other powers of the world.

The president has repeatedly stated that he will construe the act as empowering the board to find out the facts at home and abroad so as to assist him in his administration of the maximum and minimum section, and to assist in the administration of the customs laws in general by the officers of the government. With this end in view he has directed

the board to secure information as to the cost of production in this country of all goods affected by the tariff law, and the cost of their production in foreign countries. Two members of the board, Professor Emery, its chairman, and Mr. Reynolds, have already visited Europe in obedience to the president's orders. Professor Emery has recently returned for consultation, leaving Mr. Reynolds abroad pursuing the work there.

The findings and publications of the board can not hereafter fail to reach congress either directly or by a presidential message, or otherwise, and in matters of tariff legislation should expedite hearings, and furnish solid foundation for intelligent tariff schedules.

In determining the construction to be put upon the language of a legislative act, the debates at the time of its consideration and passage are regarded as important factors in discovering the intention of the legislature as to its scope and meaning.

Senator Aldrich, of Rhode Island, the chairman of the finance committee, introduced the amendment in the senate. Senator LaFollette, of Wisconsin, who was notoriously in favor of a tariff commission, charged that the provisions were purposely such as to render any action by the proposed board of little, if any, value in future tariff legislation, and that no adequate appropriation would be made. Whereupon Senator Aldrich spoke as follows:

> The duties of the commission, the parties to be named by the president, are defined in this act. They will also be defined by the president. So far as the appropriations are concerned, they will undoubtedly be made. This provision was put into the bill in good faith. It was agreed to by the senator from Indiana (Senator Beveridge) who aided in the preparation of it, and it covers all the suggestions and the requirements of the various organizations that have been asking us to provide for the appointment of a commission of this kind.

On the other hand, Senator Hale, of Maine, remarked:

> I do not understand the provisions in any way constitute a tariff commission. . . . If I believed that the provisions of the bill would do anything more than allow the president to appoint experts that might from time to time report, and, if necessary, be sent to congress by the president, and that it would be a commission such as the senator wants, I would not vote for the proposition.

Later Senator Aldrich said:

> This is not intended to be a partisan or non-partisan commission. It is intended to assist the president in carrying out the work that is assigned to him by the provisions of this section. It is also intended that they shall examine all questions pertaining to tariff matters and the products of foreign countries, so that they may have expert knowledge as to discriminations. For that purpose they will need to be acquainted with industrial conditions in this country and in other countries.

Whereupon Senator Bacon, of Georgia, interrupted and said:

> If the senator will pardon me a moment I would like to draw his attention to the fact that the amendment proposes that these appointees—whatever name

may be properly given to them—shall not only gather information for the benefit of the president in determining what shall be done under the powers given to him under the amendment, but shall gather information which shall be useful to congress in tariff legislation.

Whereupon Senator Aldrich replied, "Unquestionably." Senator Bacon dwelt further upon the subject and inquired of the senator from Rhode Island if he heard him, whereupon Senator Aldrich answered that he did. And Senator Aldrich further stated:

I think the senator will agree with me, even from that standpoint, that this information ought not to be gathered by men with a partisan bias. I can imagine nothing which would be more detrimental to the purposes which we have in view than a partisan commission sent out to gather information with reference to one political view or one economic view or another. I think it would destroy the usefulness and the purpose of this commission, or whatever you please to call it.

This occurred before the clause was changed in conference between the two houses of congress. When the clause came back in the form in which it was finally passed, it was the subject of a long debate in the senate.

Several senators, among others, Senator Newlands, of Nevada, called attention to the bill as it had passed the senate and then inquired of the chairman of the finance committee, Senator Aldrich, how the change came to be made. Senator Aldrich said that the house conferees objected *in toto* to it. He said:

The inclusion of the words was a compromise between the two houses. I will say to the senator from Nevada, of course with due deference to his judgment to the contrary, that the provision contained in the bill itself is even broader than it was in the senate, in my judgment. It allows the president to employ whomever he pleases without limit and to assign such duties to them as he sees fit within the limitation of the maximum and minimum provision, and to assist the customs officers in the discharge of their duties. Now these two purposes, especially the latter, cover every conceivable question that is covered by tariff legislation.

Whereupon Senator Newlands inquired whether the bill as it came from the conferees would warrant the president in appointing men who will inquire into and ascertain the difference in the cost of production at home and abroad, of the articles covered by the tariff. Whereupon Senator Aldrich answered:

Unquestionably it will, for the reason . . . the home valuation as well as the foreign valuation of goods is a matter which has to be determined by the customs officers, and that involves, of course, all collateral questions. I have no doubt myself that the provision as it now stands is, as I have already stated, even broader than the provision which passed the senate.

Senator Beveridge then asked Senator Aldrich if he did not differ from Senator Hale when the deficiency appropriation bill was being passed, and Senator Newlands said he was about to ask the same question, to which Senator Aldrich answered that he was not present

when the senator from Maine (Senator Hale) made a statement on that subject, "but," he said, "I am stating my own views, which are clearly carried out in my judgment by the language used in the act." Senator Newlands then remarked that he was much gratified to receive the assurance from the senator from Rhode Island and that it did credit to that senator's good faith and to his maintenance of his obligation to the senate.

Senator Aldrich then said:

> I think I can say, without betraying the confidence of the president, that the views which I entertain are also the views entertained by the president of the United States.

This language of Senator Aldrich, who was chairman of the committee which had charge of the bill in the senate, and who was one of the conferees, was frequently quoted afterwards in the debate, particularly by Senator Beveridge, who was and is in favor of a tariff board with sufficient powers to make itself useful, and the bill was passed with that understanding in the senate. In the house after the conference, the debate was general and nothing contrary to the senate's intention occurred.

For the work of the board the present congress at its last session appropriated two hundred and fifty thousand dollars in the last sundry civil appropriation bill, which contains the following:

> To enable the president to secure information to assist him in the discharge of the duties imposed upon him by section 2 of the act entitled "An act to provide revenues, equalize the duties, and encourage the industries of the United States, and for other purposes," approved August 5, 1909, and the officers of the government in administering the customs laws, including such investigations of the cost of production of commodities, covering cost of material, fabrication and every other element of such cost of production, as are authorized by said act, and including the employment of such persons as may be required for those purposes, and to enable him to do any and all things in connection therewith authorized by law, $250,000.

This new provision, while it refers for authority to the old act, is indicative of the construction thereof which has been hereinbefore stated.

The limitations of the tariff board are in the absence of ways and means of obtaining evidence in regard to the facts about which it is to secure information. It has no power to summon witnesses or compel the production of books or papers. If, however, the board shall have access to the facts in the possession of other governmental agencies, such as the consular and secret revenue service, the bureau of corporations in the department of commerce and labor, and of the officers of the government, who have charge of the collection of the corporation tax (if that is held to be constitutional), the ways and means which are otherwise lacking will be largely provided for. Under the law the president can direct all other governmental agencies to aid

the board and to permit it and its agents, to examine all papers, statistics, evidence, files, etc., in their custody. Such a course would commend itself on the ground of dispensing with duplication of labor and therefore saving expense to the government.

From these considerations it will appear that the scope of the act providing for the tariff board is sufficiently broad for present purposes, and the only action from congress needed is to provide adequate appropriations. To bring about this result, the continued interest, on the part of all persons who desire intelligent tariff laws, and their reasonable and honest administration, is required.

The board can not assume or be given the congressional prerogative of making the rates any more than the president can make the rates under this law. He can proclaim the event, upon the happening of which congress says the different rates shall go into effect. The Supreme Court so held in Field *vs.* Clark, 143 U. S., 692.

As time shows the necessity, and the work of the board commends itself, or requires it, changes doubtless will be needed in the law; notably some provision authorizing the tariff board to present the facts directly to the ways and means committee, whenever any tariff legislation is before congress. The board should furnish data and memoranda with verifying witnesses, who could be examined by the ways and means committee and by parties interested. In this way the whole people of the country would be represented before the committee in a substantial manner, where now they are practically unrepresented so far as the presentation of the case by witnesses and counsel is concerned. As a check upon the accuracy of the work of the board, parties interested should have the privilege of cross-examination, and also the right to bring before the congressional committee, which is independent of the board and of the department to which it belongs, experts of their own; these experts in turn to be subject to cross-examination by counsel representing the tariff board.

Congress has taken a great step towards the scientific disentanglement of the tariff subject, and towards the consequent enlargement of our foreign trade, and it only remains for the people of the United States to give their cordial support to the board in every reasonable endeavor it makes to obtain the facts which are at the basis of the solution of this intricate and vexing question. Thus will future congresses be able and willing to deal with the tariff in an equitable way.

A SUPREME COURT OF SCIENCE

By Professor J. PEASE NORTON
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IN the government of the nations, political parties and elections are the slow methods by which national policies are determined. Movements are started in response to conditions which seem to require legislation. Gradually, these movements are combined within the political parties in the platforms of which the issues are suitably expressed. If the interests are sufficient in the combination rapidly to propagate the platform, the party comes into power. When in power, by agreement in the congress or the legislature, laws are placed upon the statute books. These laws are passed by the party after careful consideration by the committees having these matters in charge.

In all this, there is a great waste of effort, because the results are modified by small minorities who are able at tactical points to bring to bear immense pressure on individuals. In this manner, the will of the majority of the people, which is the vague desire to remedy wrongs or to perfect a better method of conserving the prosperity and of increasing the national comfort, is thwarted. As a result the laws in some instances are a generation out of date. When the situation becomes intolerable, a too radical reaction is inevitable, and, in the end, the peaceful, orderly development of a people is impaired to the great loss of the whole nation.

Now, many of the issues which divide the country, in fact all countries, into opposing camps are scientific in their nature. Long campaigns must be fought to decide policies which are capable of easy solution, if only an impartial court existed before which such issues could be tried. Just as technical questions require technical experts, technical issues require a technical court. The administration at Washington favors the establishment of a court of commerce. Why should there not be a court of science to determine questions of scientific truth, the application and the feasibility of issues based on scientific knowledge?

Let us take an example. We find there exists a powerful society with state branches and paid agents for carrying on a campaign against vaccination, which is a scientific issue. The conditions are substantially these. Many states have compulsory vaccination laws. School children are being vaccinated on a wholesale scale as a precaution

against a danger which is probably little greater than the danger of being struck by lightning. How these laws came upon the statute, books, anti-vaccinationists explain by citing illustrations of activity on the part of the lobbyists maintained by the virus makers. They say school children are being vaccinated to sell virus. Now this movement is costing a large amount of money. This society feels that pressure must be brought to bear on legislatures throughout the United States in order to modify the laws. These laws rest on the implied scientific knowledge that vaccination is efficacious in a degree sufficient to justify a wholesale application of the remedy to the people, and that the danger of smallpox is sufficient to justify the application and that no other remedy is available against the danger so desirable as the remedy called for by the compulsory vaccination laws.

We should remember that these laws were made by legislatures of states, and that the legislatures passed the laws on the recommendations of committees composed of men of average intelligence who could not have had scientific knowledge of the issue without expert testimony. Now, such laws as these are apt to be passed without careful consideration, and it is doubtful whether this scientific knowledge has been sufficiently determined. We must as scientists differentiate between traditional scientific knowledge and scientific knowledge based on evidence which is conclusive enough to stand the test of a court of science.

Who would not like to see a case brought against the custom of vaccination in a supreme court of science before a grand jury consisting of twenty-five scientific and engineering experts drawn from the various walks of the scientific professions. Let such a case be argued by legal counsel and all evidence introduced by experts on both sides be subject to cross examination. In a comparatively short time and at a relatively small expense, society would be in a position to know whether in the judgment of a jury of impartial experts trained to the weighing of real scientific facts, the evidence justified the position that vaccination is clearly efficacious to a degree sufficient to justify a wholesale vaccination of little children in the schools throughout the country, and even if efficacious in such degree whether the danger of smallpox is sufficient to justify the application of the precaution, and further that no other remedy, less dangerous and less costly or more efficacious exists, such, for instance, as effective quarantine, which is considered by the anti-vaccinationists to be the more desirable. In such a way, this question, which has disturbed us for forty years or more and will furnish a running agitation for a decade or two longer in all probability, could be settled once for all with dispatch.

Before such a court of science, all interested parties could appear with experts, on the one side the virus manufacturers, the physicians

and those public-health officials who believe in the practise, and on the other side the taxpayers and the people represented by the government. The findings of such a court would be of great service to lawmakers and other courts of the land. For the virus makers and the physicians are not the only interests which are interested in vaccinating the people for something. The laws which have been passed are countless in number. If all laws could be declared void which were based on implied scientific knowledge which is false or not proven, a vast number of undesirable laws could be economically erased. Most laws passed for grafting purposes would fail in a court of science.

When we consider how many are the issues which disturb the country and which cause the expenditure of millions of dollars in agitation to no good result, and, at the same time, the ease with which many of the disputed scientific issues could be settled, the desirability of a court of science with proper rules of procedure is apparent. It is amazing to consider the struggles which occur, the endless substantiations of a position for or against an "ism" by arrays of opinions, the violent charge and counter charge of factions and parties, all of which might be settled by a court of science. All that is required is a relatively small expenditure for the collection and the presentation of the evidence.

When the costly agitations of the past are analyzed, such as a tariff on any commodity for the purpose of "protection," "silver sixteen to one," "vaccination compulsory," "vaccination voluntary without quarantine," as in Minnesota, "conservation"—in short, the countless "isms," why should they not be settled in a court? When such "isms" become popular enough to become the basis or the cause of legislation which means that the "isms" are to be forced on others than on believers, then it would seem that those who favor the "ism" should be placed on trial before a scientific jury in the supreme court of science. Many issues may be narrowed down to the determination of a few simple questions which may be answered by a jury of intelligent men. In what degree is the "ism" efficacious and does the degree of truth found justify the application? On the side of the conditions to be remedied, are the facts grievous enough to justify a general remedy? Is there no other remedy more efficacious?

Should the supreme court of science decide after a fair trial that compulsory vaccination was indefensible on the evidence, and that the practise of vivisection was defensible and desirable within proper limits, two costly "movements" would be ended with these findings. We may rest assured, if the supreme court of science impartially decided on the evidence in accordance with a regular procedure, that the truth would prevail with far greater dispatch than under the present system of countless "movements." Many of these associations have an

income just about sufficient to make the "wheels go round" in the office and the surplus available wherewith to grind grain is a very small fraction of the funds required to keep the wheels in motion. Under the billing system for small dues from hundreds of members and new membership campaigns, often seventy-five to one hundred per cent. of the funds are consumed. Instead of wasting so much capital in beating the tom-toms and in asserting and defending from attack alleged scientific knowledge, one quarter of the energy would be sufficient to settle these scientific questions for all time if expended in bringing the evidence suitably before an impartial scientific tribunal whose decision would command respect. With the same decision, much agitation and annoyance would be saved our good people, who are wearing themselves out trying to form intelligent opinions on all kinds of technical questions without proper evidence presented on either side.

THE MORAL EQUIVALENT OF WAR[1]

By WILLIAM JAMES

THE war against war is going to be no holiday excursion or camping party. The military feelings are too deeply grounded to abdicate their place among our ideals until better substitutes are offered than the glory and shame that come to nations as well as to individuals from the ups and downs of politics and the vicissitudes of trade. There is something highly paradoxical in the modern man's relation to war. Ask all our millions, north and south, whether they would vote now (were such a thing possible) to have our war for the Union expunged from history, and the record of a peaceful transition to the present time substituted for that of its marches and battles, and probably hardly a handful of eccentrics would say yes. Those ancestors, those efforts, those memories and legends, are the most ideal part of what we now own together, a sacred spiritual possession worth more than all the blood poured out. Yet ask those same people whether they would be willing in cold blood to start another civil war now to gain another similar possession, and not one man or woman would vote for the proposition. In modern eyes, precious though wars may be, they must not be waged solely for the sake of the ideal harvest. Only when forced upon one, only when an enemy's injustice leaves us no alternative, is war now thought permissible.

It was not thus in ancient times. The earlier men were hunting men, and to hunt a neighboring tribe, kill the males, loot the villages and possess the females, was the most profitable, as well as the most exciting, way of living. Thus were the more martial tribes selected, and in chiefs and peoples a pure pugnacity and love of glory came to mingle with the more fundamental appetite for plunder.

Modern war is so expensive that we feel trade to be a better avenue to plunder; but modern man inherits all the innate pugnacity and all the love of glory of his ancestors. Showing war's irrationality and horror is of no effect upon him. The horrors make the fascination. War is the *strong* life; it is life *in extremis;* war-taxes are the only ones men never hesitate to pay; as the budgets of all nations show us.

History is a bath of blood. The Iliad is one long recital of how Diomedes and Ajax, Sarpedon and Hector *killed.* No detail of the

[1] This article, published last February by the American Association for International Conciliation, is here reproduced as a tribute to the memory of William James. It was written at the suggestion of the editor of THE POPULAR SCIENCE MONTHLY.

wounds they made is spared us, and the Greek mind fed upon the story. Greek history is a panorama of jingoism and imperialism—war for war's sake, all the citizens being warriors. It is horrible reading, because of the irrationality of it all—save for the purpose of making "history"—and the history is that of the utter ruin of a civilization in intellectual respects perhaps the highest the earth has ever seen.

Those wars were purely piratical. Pride, gold, women, slaves, excitement, were their only motives. In the Peloponnesian war, for example, the Athenians ask the inhabitants of Melos (the island where the "Venus of Milo" was found), hitherto neutral, to own their lordship. The envoys meet, and hold a debate which Thucydides gives in full, and which, for sweet reasonableness of form, would have satisfied Matthew Arnold. "The powerful exact what they can," said the Athenians, "and the weak grant what they must." When the Meleans say that sooner than be slaves they will appeal to the gods, the Athenians reply: "Of the gods we believe and of men we know that, by a law of their nature, wherever they can rule they will. This law was not made by us, and we are not the first to have acted upon it; we did but inherit it, and we know that you and all mankind, if you were as strong as we are, would do as we do. So much for the gods; we have told you why we expect to stand as high in their good opinion as you." Well, the Meleans still refused, and their town was taken. "The Athenians," Thucydides quietly says, "thereupon put to death all who were of military age and made slaves of the women and children. They then colonized the island, sending thither five hundred settlers of their own."

Alexander's career was piracy pure and simple, nothing but an orgy of power and plunder, made romantic by the character of the hero. There was no rational principle in it, and the moment he died his generals and governors attacked one another. The cruelty of those times is incredible. When Rome finally conquered Greece, Paulus Æmilius was told by the Roman Senate to reward his soldiers for their toil by "giving" them the old kingdom of Epirus. They sacked seventy cities and carried off a hundred and fifty thousand inhabitants as slaves. How many they killed I know not; but in Etolia they killed all the senators, five hundred and fifty in number. Brutus was "the noblest Roman of them all," but to reanimate his soldiers on the eve of Philippi he similarly promises to give them the cities of Sparta and Thessalonica to ravage, if they win the fight.

Such was the gory nurse that trained societies to cohesiveness. We inherit the warlike type; and for most of the capacities of heroism that the human race is full of we have to thank this cruel history. Dead men tell no tales, and if there were any tribes of other type than this they have left no survivors. Our ancestors have bred pugnacity into our bone and marrow, and thousands of years of peace won't breed it

out of us. The popular imagination fairly fattens on the thought of wars. Let public opinion once reach a certain fighting pitch, and no ruler can withstand it. In the Boer war both governments began with bluff, but couldn't stay there, the military tension was too much for them. In 1898 our people had read the word WAR in letters three inches high for three months in every newspaper. The pliant politician McKinley was swept away by their eagerness, and our squalid war with Spain became a necessity.

At the present day, civilized opinion is a curious mental mixture. The military instincts and ideals are as strong as ever, but are confronted by reflective criticisms which sorely curb their ancient freedom. Innumerable writers are showing up the bestial side of military service. Pure loot and mastery seem no longer morally avowable motives, and pretexts must be found for attributing them solely to the enemy. England and we, our army and navy authorities repeat without ceasing, arm solely for "peace," Germany and Japan it is who are bent on loot and glory. "Peace" in military mouths to-day is a synonym for "war expected." The word has become a pure provocative, and no government wishing peace sincerely should allow it ever to be printed in a newspaper. Every up-to-date dictionary should say that "peace" and "war" mean the same thing, now *in posse,* now *in actu.* It may even reasonably be said that the intensely sharp competitive *preparation* for war by the nations *is the real war,* permanent, unceasing; and that the battles are only a sort of public verification of the mastery gained during the "peace"-interval.

It is plain that on this subject civilized man has developed a sort of double personality. If we take European nations, no legitimate interest of any one of them would seem to justify the tremendous destructions which a war to compass it would necessarily entail. It would seem as though common sense and reason ought to find a way to reach agreement in every conflict of honest interests. I myself think it our bounden duty to believe in such international rationality as possible. But, as things stand, I see how desperately hard it is to bring the peace-party and the war-party together, and I believe that the difficulty is due to certain deficiences in the program of pacificism which set the militarist imagination strongly, and to a certain extent justifiably, against it. In the whole discussion both sides are on imaginative and sentimental ground. It is but one utopia against another, and everything one says must be abstract and hypothetical. Subject to this criticism and caution, I will try to characterize in abstract strokes the opposite imaginative forces, and point out what to my own very fallible mind seems the best utopian hypothesis, the most promising line of conciliation.

In my remarks, pacificist though I am, I will refuse to speak of the bestial side of the war-régime (already done justice to by many

writers) and consider only the higher aspects of militaristic sentiment. Patriotism no one thinks discreditable; nor does any one deny that war is the romance of history. But inordinate ambitions are the soul of every patriotism, and the possibility of violent death the soul of all romance. The militarily patriotic and romantic-minded everywhere, and especially the professional military class, refuse to admit for a moment that war may be a transitory phenomenon in social evolution. The notion of a sheep's paradise like that revolts, they say, our higher imagination. Where then would be the steeps of life? If war had ever stopped, we should have to re-invent it, on this view, to redeem life from flat degeneration.

Reflective apologists for war at the present day all take it religiously. It is a sort of sacrament. Its profits are to the vanquished as well as to the victor; and quite apart from any question of profit, it is an absolute good, we are told, for it is human nature at its highest dynamic. Its "horrors" are a cheap price to pay for rescue from the only alternative supposed, of a world of clerks and teachers, of co-education and zoophily, of "consumer's leagues" and "associated charities," of industrialism unlimited, and feminism unabashed. No scorn, no hardness, no valor any more! Fie upon such a cattleyard of a planet!

So far as the central essence of this feeling goes, no healthy minded person, it seems to me, can help to some degree partaking of it. Militarism is the great preserver of our ideals of hardihood, and human life with no use for hardihood would be contemptible. Without risks or prizes for the darer, history would be insipid indeed; and there is a type of military character which every one feels that the race should never cease to breed, for every one is sensitive to its superiority. The duty is incumbent on mankind, of keeping military characters in stock —of keeping them, if not for use, then as ends in themselves and as pure pieces of perfection—so that Roosevelt's weaklings and molly-coddles may not end by making everything else disappear from the face of nature.

This natural sort of feeling forms, I think, the innermost soul of army-writings. Without any exception known to me, militarist authors take a highly mystical view of their subject, and regard war as a biological or sociological necessity, uncontrolled by ordinary psychological checks and motives. When the time of development is ripe the war must come, reason or no reason, for the justifications pleaded are invariably fictitious. War is, in short, a permanent human *obligation*. General Homer Lea, in his recent book "The Valor of Ignorance," plants himself squarely on this ground. Readiness for war is for him the essence of nationality, and ability in it the supreme measure of the health of nations.

Nations, General Lea says, are never stationary—they must necessarily expand or shrink, according to their vitality or decrepitude. Japan now is culminating; and by the fatal law in question it is impossible that her statesmen should not long since have entered, with extraordinary foresight, upon a vast policy of conquest—the game in which the first moves were her wars with China and Russia and her treaty with England, and of which the final objective is the capture of the Philippines, the Hawaiian Islands, Alaska and the whole of our coast west of the Sierra passes. This will give Japan what her ineluctable vocation as a state absolutely forces her to claim, the possession of the entire Pacific Ocean; and to oppose these deep designs we Americans have, according to our author, nothing but our conceit, our ignorance, our commercialism, our corruption, and our feminism. General Lea makes a minute technical comparison of the military strength which we at present could oppose to the strength of Japan, and concludes that the islands, Alaska, Oregon and southern California, would fall almost without resistance, that San Francisco must surrender in a fortnight to a Japanese investment, that in three or four months the war would be over, and our republic, unable to regain what it had heedlessly neglected to protect sufficiently, would then "disintegrate," until perhaps some Cæsar should arise to weld us again into a nation.

A dismal forecast indeed! Yet not unplausible, if the mentality of Japan's statesmen be of the Cæsarian type of which history shows so many examples, and which is all that General Lea seems able to imagine. But there is no reason to think that women can no longer be the mothers of Napoleonic or Alexandrian characters; and if these come in Japan and find their opportunity, just such surprises as "The Valor of Ignorance" paints may lurk in ambush for us. Ignorant as we still are of the innermost recesses of Japanese mentality, we may be foolhardy to disregard such possibilities.

Other militarists are more complex and more moral in their considerations. The "Philosophie des Krieges," by S. R. Steinmetz is a good example. War, according to this author, is an ordeal instituted by God, who weighs the nations in its balance. It is the essential form of the state, and the only function in which peoples can employ all their powers at once and convergently. No victory is possible save as the resultant of a totality of virtues, no defeat for which some vice or weakness is not responsible. Fidelity, cohesiveness, tenacity, heroism, conscience, education, inventiveness, economy, wealth, physical health and vigor—there isn't a moral or intellectual point of superiority that doesn't tell, when God holds his assizes and hurls the peoples upon one another. *Die Weltgeschichte ist das Weltgericht;* and Dr. Steinmetz

does not believe that in the long run chance and luck play any part in apportioning the issues.

The virtues that prevail, it must be noted, are virtues anyhow, superiorities that count in peaceful as well as in military competition; but the strain on them, being infinitely intenser in the latter case, makes war infinitely more searching as a trial. No ordeal is comparable to its winnowings. Its dread hammer is the welder of men into cohesive states, and nowhere but in such states can human nature adequately develop its capacity. The only alternative is "degeneration."

Dr. Steinmetz is a conscientious thinker, and his book, short as it is, takes much into account. Its upshot can, it seems to me, be summed up in Simon Patten's word, that mankind was nursed in pain and fear, and that the transition to a "pleasure-economy" may be fatal to a being wielding no powers of defense against its disintegrative influences. If we speak of the *fear of emancipation from the fear-régime,* we put the whole situation into a single phrase; fear regarding ourselves now taking the place of the ancient fear of the enemy.

Turn the fear over as I will in my mind, it all seems to lead back to two unwillingnesses of the imagination, one esthetic, and the other moral: unwillingness, first to envisage a future in which army-life, with its many elements of charm, shall be forever impossible, and in which the destinies of peoples shall nevermore be decided quickly, thrillingly and tragically, by force, but only gradually and insipidly by "evolution"; and, secondly, unwillingness to see the supreme theater of human strenuousness closed, and the splendid military aptitudes of men doomed to keep always in a state of latency and never show themselves in action. These insistent unwillingnesses, no less than other esthetic and ethical insistencies have, it seems to me, to be listened to and respected. One can not meet them effectively by mere counter-insistency on war's expensiveness and horror. The horror makes the thrill; and when the question is of getting the extremest and supremest out of human nature, talk of expense sounds ignominious. The weakness of so much merely negative criticism is evident—pacificism makes no converts from the military party. The military party denies neither the bestiality nor the horror, nor the expense; it only says that these things tell but half the story. It only says that war is *worth* them; that, taking human nature as a whole, its wars are its best protection against its weaker and more cowardly self, and that mankind can not *afford* to adopt a peace-economy.

Pacificists ought to enter more deeply into the esthetical and ethical point of view of their opponents. Do that first in any controversy, says J. J. Chapman, *then move the point,* and your opponent will follow. So long as anti-militarists propose no substitute for war's disciplinary function, no *moral equivalent* of war, analogous, as one might say, to

the mechanical equivalent of heat, so long they fail to realize the full inwardness of the situation. And as a rule they do fail. The duties, penalties and sanctions pictured in the utopias they paint are all too weak and tame to touch the military-minded. Tolstoy's pacificism is the only exception to this rule, for it is profoundly pessimistic as regards all this world's values, and makes the fear of the Lord furnish the moral spur provided elsewhere by the fear of the enemy. But our socialistic peace-advocates all believe absolutely in this world's values; and instead of the fear of the Lord and the fear of the enemy, the only fear they reckon with is the fear of poverty if one be lazy. This weakness pervades all the socialistic literature with which I am acquainted. Even in Lowes Dickinson's exquisite dialogue,[2] high wages and short hours are the only forces invoked for overcoming man's distaste for repulsive kinds of labor. Meanwhile men at large still live as they always have lived, under a pain-and-fear economy—for those of us who lived in an ease-economy are but an island in the stormy ocean—and the whole atmosphere of present-day utopian literature tastes mawkish and dishwatery to people who still keep a sense for life's more bitter flavors. It suggests, in truth, ubiquitous inferiority.

Inferiority is always with us, and merciless scorn of it is the keynote of the military temper. "Dogs, would you live forever?" shouted Frederick the Great. "Yes," say our utopians, "let us live forever, and raise our level gradually." The best thing about our "inferiors" to-day is that they are as tough as nails, and physically and morally almost as insensitive. Utopianism would see them soft and squeamish, while militarism would keep their callousness, but transfigure it into a meritorious characteristic, needed by "the service," and redeemed by that from the suspicion of inferiority. All the qualities of a man acquire dignity when he knows that the service of the collectivity that owns him needs them. If proud of the collectivity, his own pride rises in proportion. No collectivity is like an army for nourishing such pride; but it has to be confessed that the only sentiment which the image of pacific cosmopolitan industrialism is capable of arousing in countless worthy breasts is shame at the idea of belonging to *such* a collectivity. It is obvious that the United States of America as they exist to-day impress a mind like General Lea's as so much human blubber. Where is the sharpness and precipitousness, the contempt for life, whether one's own, or another's? Where is the savage "yes" and "no," the unconditional duty? Where is the conscription? Where is the blood-tax? Where is anything that one feels honored by belonging to?

Having said thus much in preparation, I will now confess my own utopia. I devoutly believe in the reign of peace and in the gradual

[2] "Justice and Liberty," New York, 1909.

advent of some sort of a socialistic equilibrium. The fatalistic view of the war-function is to me nonsense, for I know that war-making is due to definite motives and subject to prudential checks and reasonable criticisms, just like any other form of enterprise. And when whole nations are the armies, and the science of destruction vies in intellectual refinement with the sciences of production, I see that war becomes absurd and impossible from its own monstrosity. Extravagant ambitions will have to be replaced by reasonable claims, and nations must make common cause against them. I see no reason why all this should not apply to yellow as well as to white countries, and I look forward to a future when acts of war shall be formally outlawed as between civilized peoples.

All these beliefs of mine put me squarely into the anti-militarist party. But I do not believe that peace either ought to be or will be permanent on this globe, unless the states pacifically organized preserve some of the old elements of army-discipline. A permanently successful peace-economy can not be a simple pleasure-economy. In the more or less socialistic future towards which mankind seems drifting we must still subject ourselves collectively to those severities which answer to our real position upon this only partly hospitable globe. We must make new energies and hardihoods continue the manliness to which the military mind so faithfully clings. Martial virtues must be the enduring cement; intrepidity, contempt of softness, surrender of private interest, obedience to command, must still remain the rock upon which states are built—unless, indeed, we wish for dangerous reactions against commonwealths fit only for contempt, and liable to invite attack whenever a center of crystallization for military-minded enterprise gets formed anywhere in their neighborhood.

The war-party is assuredly right in affirming and reaffirming that the martial virtues, although originally gained by the race through war, are absolute and permanent human goods. Patriotic pride and ambition in their military form are, after all, only specifications of a more general competitive passion. They are its first form, but that is no reason for supposing them to be its last form. Men now are proud of belonging to a conquering nation, and without a murmur they lay down their persons and their wealth, if by so doing they may fend off subjection. But who can be sure that *other aspects of one's country* may not, with time and education and suggestion enough, come to be regarded with similarly effective feelings of pride and shame? Why should men not some day feel that it is worth a blood-tax to belong to a collectivity superior in *any* ideal respect? Why should they not blush with indignant shame if the community that owns them is vile in any way whatsoever? Individuals, daily more numerous, now feel this civic passion. It is only a question of blowing on the spark till the

whole population gets incandescent, and on the ruins of the old morals of military honor, a stable system of morals of civic honor builds itself up. What the whole community comes to believe in grasps the individual as in a vise. The war-function has graspt us so far; but constructive interests may some day seem no less imperative, and impose on the individual a hardly lighter burden.

Let me illustrate my idea more concretely. There is nothing to make one indignant in the mere fact that life is hard, that men should toil and suffer pain. The planetary conditions once for all are such, and we can stand it. But that so many men, by mere accidents of birth and opportunity, should have a life of *nothing else* but toil and pain and hardness and inferiority imposed upon them, should have *no* vacation, while others natively no more deserving never get any taste of this campaigning life at all—*this* is capable of arousing indignation in reflective minds. It may end by seeming shameful to all of us that some of us have nothing but campaigning, and others nothing but unmanly ease. If now—and this is my idea—there were, instead of military conscription a conscription of the whole youthful population to form for a certain number of years a part of the army enlisted against *nature,* the injustice would tend to be evened out, and numerous other goods to the commonwealth would follow. The military ideals of hardihood and discipline would be wrought into the growing fiber of the people; no one would remain blind as the luxurious classes now are blind, to man's real relations to the globe he lives on, and to the permanently sour and hard foundations of his higher life. To coal and iron mines, to freight trains, to fishing fleets in December, to dishwashing, clothes-washing and window-washing, to road-building and tunnel-making, to foundries and stoke-holes, and to the frames of skyscrapers, would our gilded youths be drafted off, according to their choice, to get the childishness knocked out of them, and to come back into society with healthier sympathies and soberer ideas. They would have paid their blood-tax, done their own part in the immemorial human warfare against nature, they would tread the earth more proudly, the women would value them more highly, they would be better fathers and teachers of the following generation.

Such a conscription, with the state of public opinion that would have required it, and the many moral fruits it would bear, would preserve in the midst of a pacific civilization the manly virtues which the military party is so afraid of seeing disappear in peace. We should get toughness without callousness, authority with as little criminal cruelty as possible, and painful work done cheerily because the duty is temporary, and threatens not, as now, to degrade the whole remainder of one's life. I spoke of the "moral equivalent" of war. So far, war has been the only force that can discipline a whole community, and until

an equivalent discipline is organized, I believe that war must have its way. But I have no serious doubt that the ordinary prides and shames of social man, once developed to a certain intensity, are capable of organizing such a moral equivalent as I have sketched, or some other just as effective for preserving manliness of type. It is but a question of time, of skillful propagandism, and of opinion-making men seizing historic opportunities.

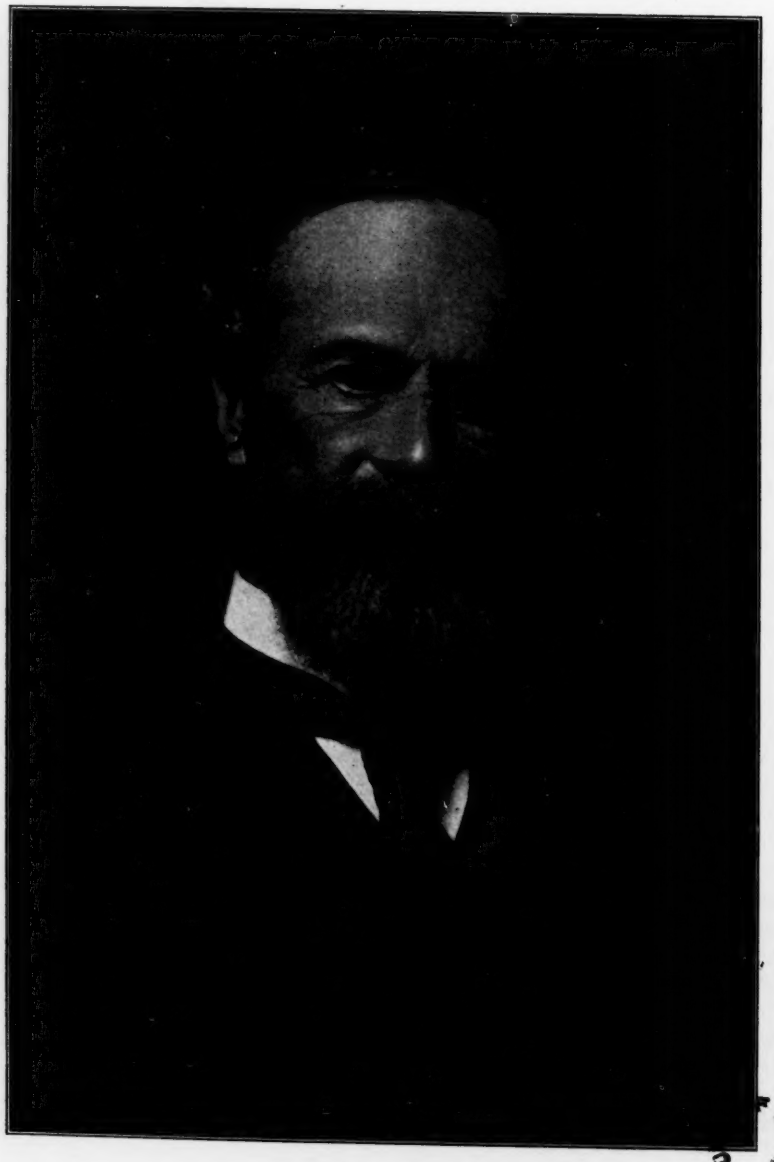
The martial type of character can be bred without war. Strenuous honor and disinterestedness abound elsewhere. Priests and medical men are in a fashion educated to it, and we should all feel some degree of it imperative if we were conscious of our work as an obligatory service to the state. We should be *owned,* as soldiers are by the army, and our pride would rise accordingly. We could be poor, then, without humiliation, as army officers now are. The only thing needed henceforward is to inflame the civic temper as past history has inflamed the military temper. H. G. Wells, as usual, sees the center of the situation. "In many ways," he says, "military organization is the most peaceful of activities. When the contemporary man steps from the street, of clamorous insincere advertisement, push, adulteration, underselling and intermittent employment, into the barrack-yard, he steps on to a higher social plane, into an atmosphere of service and cooperation and of infinitely more honorable emulations. Here at least men are not flung out of employment to degenerate because there is no immediate work for them to do. They are fed and drilled and trained for better services. Here at least a man is supposed to win promotion by self-forgetfulness, and not by self-seeking. And beside the feeble and irregular endowment of research by commercialism, its little short-sighted snatches at profit by innovation and scientific economy, see how remarkable is the steady and rapid development of method and appliances in naval and military affairs! Nothing is more striking than to compare the progress of civil conveniences which has been left almost entirely to the trader, to the progress in military apparatus during the last few decades. The house-appliances of to-day, for example, are little better than they were fifty years ago. A house of to-day is still almost as ill-ventilated, badly heated by wasteful fires, clumsily arranged and furnished as the house of 1858. Houses a couple of hundred years old are still satisfactory places of residence, so little have our standards risen. But the rifle or battleship of fifty years ago was beyond all comparison inferior to those we possess; in power, in speed, in convenience alike. No one has a use now for such superannuated things." [3]

Wells adds[4] that he thinks that the conceptions of order and discipline, the tradition of service and devotion, of physical fitness, un-

[3] "First and Last Things," 1908, p. 215.

[4] *Ibid.,* p. 226.

stinted exertion and universal responsibility, which universal military duty is now teaching European nations, will remain a permanent acquisition, when the last ammunition has been used in the fireworks that celebrate the final peace. I believe as he does. It would be simply preposterous if the only force that could work ideals of honor and standards of efficiency into English or American natures should be the fear of being killed by the Germans or the Japanese. Great indeed is fear; but it is not, as our military enthusiasts believe and try to make us believe, the only stimulus known for awakening the higher ranges of men's spiritual energy. The amount of alteration in public opinion which my utopia postulates is vastly less than the difference between the mentality of those black warriors who pursued Stanley's party on the Congo with their cannibal war-cry of "meat! meat" and that of the "general staff" of any civilized nation. History has seen the latter interval bridged over: the former one can be bridged over much more easily.



WILLIAM JAMES

THE PROGRESS OF SCIENCE

WILLIAM JAMES

Is there left to us in this land a man so great as William James? If the list of our leaders is scanned, men eminent in philosophy, science, art or letters, in education, law, politics or business, is there a single one to be placed beside him? He excelled in so many ways, in science, in philosophy, in letters, as a teacher, as a leader in good causes and lost causes, before all as a man—kind and generous beyond measure, of remarkable individuality and distinction.

The "Principles of Psychology," published in 1890, is a scientific and literary classic. No one can foretell whether it will be permanently in the group of philosophical masterpieces, beginning with the dialogues of Plato, but there is no contemporary American work and possibly no European work since the "Origin of Species," which has an equal chance.

Wilhelm Wundt and William James are the founders of psychology, a science which in a single generation has assumed a place coordinate with the other leading sciences. Both men—like their forerunners, Lotze and von Helmholtz—had an education in medicine and the natural sciences, with strong natural interests in philosophy and metaphysics. They established laboratories of psychology at about the same time, neither of them did experimental work of consequence, both prepared treatises which to a remarkable extent established the lines of development for a science. Wundt's "Physiologische Psychologie" is more systematic than James's "Principles of Psychology"; it is more of an encyclopedia. For that reason it could be brought out in various editions, corrected and enlarged. James's "Psychology" is more of a work of art, exhibiting the subject as he left it twenty years ago.

It is truly a remarkable book, combining physiology, pathological psychology, comparative psychology, experimental psychology, introspective psychology and philosophy into one whole which has dominated the science. The author is always accurate in his scientific material and clear in his statements, but frank in his criticism and daring in his conclusions. His own contributions on the stream of thought, the perception of things and of space, the emotions, instinct, habit and in many other directions are of fundamental importance. The work has an extraordinary vitality and individuality which make it a work of art and a classic.

In his "Talks to Teachers" and "Varieties of Religious Experience," James extended the field of psychology in two important directions. Nearly all his work was done in a somewhat opportunistic fashion. He made an engagement to give lectures, perhaps cancelled it or tried to do so, felt he could not prepare them and finally produced a masterpiece. "The Will to Believe" was a collection of addresses; the volume on "Religious Experience" was Gifford lectures, the "Pragmatism" Lowell lectures, "A Pluralistic Universe" Hibbert lectures.

Although the interest in problems of philosophy and the pluralism, pragmatism and empiricism may be traced backward to his earlier publications, they were given full and vigorous expression only in these later volumes, when James had passed the age of sixty and was already suffering from disease of the heart. It would be idle

to attempt to give here an exposition of James's attitude in philosophy. Pragmatism—the term was first used by James's friend, Charles S. Peirce, in this journal—is called on the title page of his book "a new name for an old way of thinking." It is largely the method of science applied to philosophy, but it is after all what James thought and said and wrote. His personality and its expression, the intellect swayed by the will and the emotions, have made a deep impression not only on professional philosophy, but in the world of men.

James inherited his brilliant literary skill from his father and shared it with his brother. His education was long and irregular. He did not graduate from Harvard, but studied art and was with Agassiz in Brazil. From 1872 to 1880 he was instructor and assistant professor of comparative anatomy and physiology at Harvard, then professor of philosophy, then of psychology and then again of philosophy.

It is not probable that James left unpublished manuscripts, but his letters would form a volume of surpassing interest, though it may be that they are too personal for publication. The writer ventures to reproduce the concluding parts of the last two which he received, the one from Cambridge and the other from Bad Nauheim, where he had gone for treatment of the disease that so soon proved fatal. James at first declined on account of his health to accept the active presidency of the International Congress of Psychology to be held in this country. There was no one else to take the place, so when difficulties arose he played his part with characteristic loyalty and self-sacrifice.

My own refusal was imperatively conditioned by the state of my circulatory organs I had to introduce Boutroux to his audience 2 days ago, and could hardly speak for dyspnoea. Yours ever, W. J.

NATIONAL AND INTERNATIONAL SCIENTIFIC CONGRESSES

Among the various gatherings of scientific men held during the present summer two American meetings and several international congresses were of special importance. The national conservation congress held at St. Paul at the beginning of September was a truly notable event, bringing together men eminent in various pursuits to consider problems which are essentially scientific in character. President Taft's admirable address—printed in the present issue of the Monthly in its authorized form—shows how carefully he has considered questions which touch public policy on one side and science on the other. Mr. Taft stated that he inherited the policy of conservation from his predecessor, and Mr. Roosevelt and several leading members of his administration, Mr. Pinchot, Mr. Garfield and Mr. Wilson, took an active part in the proceedings. Governors of states and many men prominent in education, in philan-

the line of least discussion will be to keep the committee as fixed with me a president Log, you can be Vice-president Stork, and aid Watson with your counsel; and I hope that will also co-operate again. I wish "I had never said I would not play at President! If I can't preside when the time comes, I reserve the right to vote whomever I damn please to take the chair.

Pray agree; and help to quench the inconceivable paltriness of spirit that seems to have shown its head for the 1st time in our American psychological world! Yours ever truly,

Wm. James

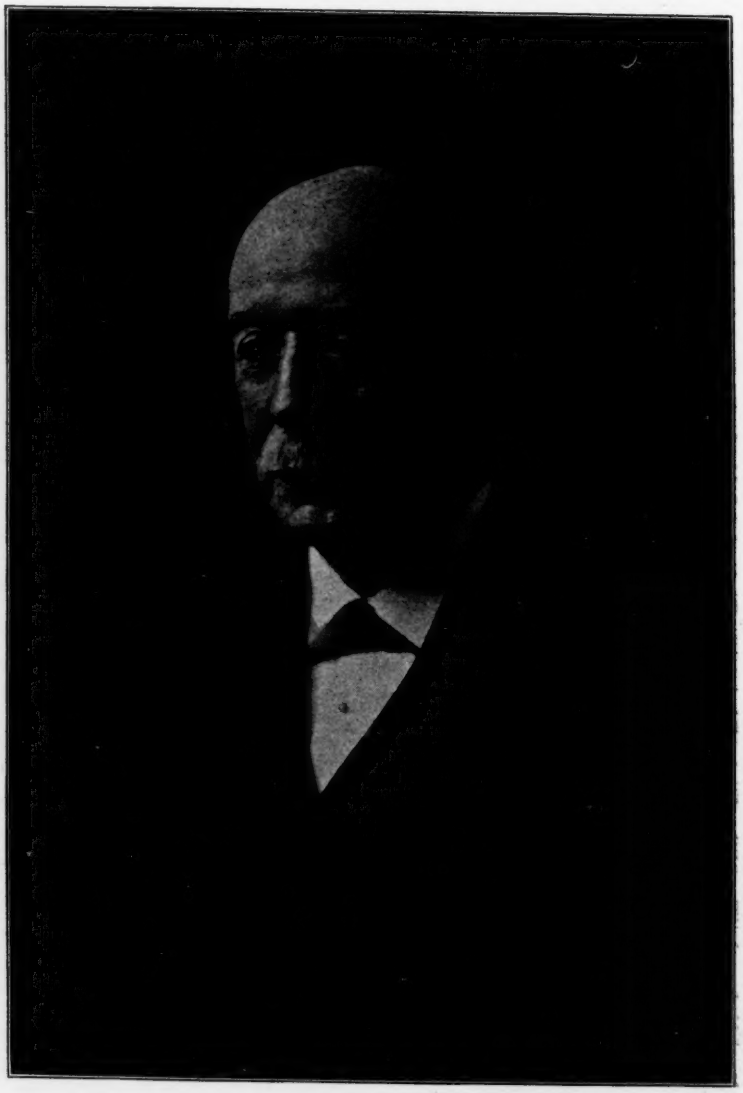
thropy and in affairs made addresses. Men eminent in scientific research were not so well represented as they should have been, but the names of Professor Bailey, of Cornell, Professor Wesbrook, of Minnesota, and Dr. W J McGee were on the program.

The American Chemical Society emphasized its national character by meeting in San Francisco. The American Association for the Advancement of Science had also planned a visit to the Pacific coast and to Hawaii, but transportation across the sea could not be arranged. The chemists had a special train from Chicago, which carried over a hundred to California, where arrangements were made for elaborate entertainments and excursions and a scientific program under the presidency of Professor Bancroft, of Cornell.

The International Geological Congress met this year at Stockholm, the International Zoological Congress at Buda Pesth, the first International Congress of Entomology and the International Congress of Anatomists at Brussels, and the International Physiological Congress at Vienna. These meetings were attended by scientific men from all parts of the world, including large numbers from this country. The Zoological Congress met last time in Boston and the Geological Congress will hold its next meeting in Canada. America and American scientific men are taking an increasing share in these international congresses, which within the past few years have assumed an important part in the advancement of science.

SCIENTIFIC ITEMS

WE regret to record the deaths of Dr. Charles Anthony Goessmann, since 1869 professor of chemistry at the Massachusetts Agricultural College, known for his important contributions to agricultural chemistry; of William Earl Dodge Scott, curator of ornithology at Princeton University, and of Dr. Paul Mantegazza, the eminent Italian anthropologist.

THE national memorial to Grover Cleveland is to take the form of a tower to be erected at Princeton as part of the buildings of the graduate school, with which Mr. Cleveland was closely identified during the last years of his life. The tower will be about 150 feet high and 40 feet square. It will cost $100,000, of which sum $75,000 have already been given.

PROFESSOR JOSEPH A. HOLMES, of the U. S. Geological Survey, formerly professor of geology and natural history at the University of North Carolina and state geologist, has been appointed by President Taft director of the newly-established Bureau of Mines. —Among the representatives appointed to attend the opening of the Mexican National University on September 22 are Professor F. W. Putnam and Roland B. Dixon, from Harvard University, and Professor Franz Boas, from Columbia University.